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OCTOBER, 1905.

VOL. XXVI. NO. 4.

The Geographical Journal

INCLUDING THE PROCEEDINGS OF THE ROYAL GEOGRAPHICAL SOCIETY.

SUMMARY OF CONTENTS.

(For Details, see over.)

	PAGE
Exploration and Survey with the Tibet Frontier Commission, and from Gyangtse to Simla viâ Gartok. By Major C. H. D. RYDER, D.S.O., R.E.	369
On the Nile Flood and its Variation. By Captain H. G. LYONS, F.R.G.S., F.G.S., Director-General Survey Department, Egypt	395
Some Further Notes concerning the Liao Ho. By Lieut.-Colonel A. W. S. WINGATE	421
The Field of Geography and Some of its Problems. By Rear-Admiral Sir W. J. L. WHARTON, K.C.B., F.R.S.	429
Reviews	443
The Monthly Record	450
Obituary	461
Correspondence	462
Geographical Literature of the Month	469
New Maps	475
Maps and Illustrations.	

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For Notices as to the Society's Meetings and other important matter, see p. iv.

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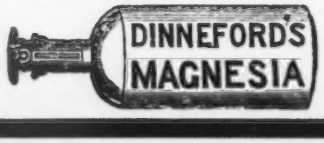

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NATURE AND OBJECTS.

THE ROYAL GEOGRAPHICAL SOCIETY was founded in 1830 for the Advancement of Geographical Science. It received a Royal Charter of Incorporation in 1859.

The Society's affairs are managed through a Council consisting of a President, Vice-Presidents, Treasurer, Trustees, Secretaries and twenty-one other Fellows, elected annually at a General Meeting of the Fellows.

The Society carries out the object for which it exists—

(1) By holding Meetings at regular intervals during the Session (November to June), at which communications are made and discussed by travellers, explorers and geographers, dealing with new discoveries, and with other matters pertaining to the field of geography.

(2) By the publication monthly of the *Geographical Journal*, in which are contained not only the communications made directly to the Society, but articles, notes and correspondence relating to geography and travel all over the world, and also a bibliography of all books, papers and articles dealing with geography published during the month, and lists of all the most important maps issued. The *Journal* is amply supplied with new maps and illustrations. It is sent free to all Fellows.

(3) By the issue of other occasional publications and maps.

(4) By the maintenance of a Library and a Collection of Maps and Photographs. The Library numbers over 50,000 volumes; there are 120,000 maps and 25,000 photographs. The Library and Map Room are open to all Fellows, and there is ample accommodation in the Society's House for reading and research. Each Fellow is entitled to borrow four volumes at a time.

(5) By the assistance rendered by the staff to those in search of geographical information.

(6) By carrying on a system of instruction for intending travellers in various branches connected with geography.

(7) By contributing to the expenses of exploring expeditions. and by lending instruments to travellers who are competent to use them.

(8) By encouraging, directly and indirectly, the improvement of geographical education.

(9) By the award annually of medals and other honours to distinguished travellers and geographers.

His Majesty the King is Patron of the Society, and H.R.H. the Prince of Wales Vice-Patron.

The President of the Society (1905–1906) is the Rt. Hon. Sir George Taubman Goldie, K.C.M.G., F.R.S., D.C.L., LL.D.

Candidates for admission into the Society must be proposed and seconded by Fellows, and it is necessary that the description and residence of such Candidates should be clearly stated on their Certificates.

It is provided by Chapter IV., § 1, of the Regulations, that,

"Every Ordinary Fellow shall, on his election, be required to pay £5 as his "admission fee, and £2 as his first annual subscription, or he may compound either "at his entrance by one payment of £35, or at any subsequent period on the following "basis:—

"Fellows of 20 years' standing and over	..	..	..	£12 10s.
" 15 " " and under 20	..	..	..	£16
" 10 " " " 15	..	..	..	£20

"And no Fellow shall be entitled to vote or to enjoy any other privilege of the "Society so long as he shall continue in arrear."

All Subscriptions are payable in advance, on the 1st of January in each year.

Copies of the Regulations and Candidates' Certificates may be had on application at the Society's House, 1 Savile Row, London, W.

The Society's House is open from 10.30 A.M. to 5 P.M.; on Saturdays to 1 P.M.; and on Meeting nights to 8.15 P.M.

On the Ground Floor of the House are the Offices and Map Room.

On the First Floor the main Library and the Council Room, which is available to Fellows as a reading room when not required for Council or Committee Meetings.

On the Second Floor are the Secretary's Office, the upper Library (fitted up specially for the use of Students), and the Librarian's Room.

On the Third Floor is another portion of the Library, a Smoking Room, a Room for Instruction, the Map Draughtsman's Department, and the Map Mounter's Work Room.

On the Roof is the Observatory.

Full details with regard to the Society, with List of Fellows, &c., are given in THE YEAR BOOK, copies of which may be obtained on application.

PROVISIONAL PROGRAMME.

Ordinary Meetings.

The following are the dates on which the Ordinary Meetings of the Society will be held, at 8.30 P.M., in the Theatre, Burlington Gardens (by permission of the First Commissioner of Works) :—

1905.	Monday, November	6, 20	1906.	Monday, April		9
	„ December	4, 18		„ May 7, 21	{ *Anni-* *versary* }	
1906.	„ January	15, 29		„ June		11, 18
	„ February	12, 26				
	„ March	12, 19				

So far the following arrangements have been made :—

November 6.—Introductory Remarks by the PRESIDENT. Travels in the Mountains of Central Japan. By the Rev. WALTER WESTON, M.A.

November 20.—First Exploration of the Hoh-Lumba and Lobson Glaciers (Himalaya). By Mrs. FANNY BULLOCK WORKMAN, F.R.S.G.S.

December 4.—Exploration in the Abai Basin, Abyssinia. By H. WELD BLUNDELL.

December 11—Exploration in New Guinea (*with Cinematograph Illustrations*). By C. G. SELIGMAN.

Other provisional arrangements are as follows :—

Unexplored India. By Colonel Sir T. H. HOLDICH, K.C.M.G., K.C.I.E., C.B.

The Economic Geography of Australia. By Prof. J. W. GREGORY, F.R.S.

Survey and Exploration in Seistan. By Colonel A. H. MCMAHON, C.S.I., C.I.E.

Exploration in Tierra del Fuego. By Captain RICHARD CRAWSHAY.

Exploration in the East Tibet Borderlands. By Lieut. FILCHENER.

Explorations in Bolivia and Peru. By Baron ERLAND NORDENSKJÖLD.

The Philippine Islands. By Prof. ALLEYNE IRELAND.

Northern Rhodesia. By L. A. WALLACE.

The Geographical Influences of Water Plants in Chile. By G. F. SCOTT ELLIOT.

Maps of London. By LAURENCE GOMME.

RESEARCH DEPARTMENT :—

On the Next Great Arctic Discovery: The Beaufort Sea. By Sir CLEMENTS R. MARKHAM, K.C.B., F.R.S.

N.B.—Information as to the Society's Meetings, and other matters of interest to Fellows, is given under the head of Notices, on p. iv of the monthly parts of the *Geographical Journal.*

Extra Meetings. When considered necessary by the President and Council, Extra Meetings will be held, and will be announced in the usual way in the *Journal.*

Research Department. In addition to the Evening Meetings, occasional Afternoon Meetings of the Research Department will be held for the discussion of special subjects in Scientific and Applied Geography. Fellows of the Society are admitted to these Meetings; Non-Fellows only by special invitation. Notice of these Meetings will be given on p. iv of the *Journal.*

Anniversary Dinner and Conversazione. The Anniversary Dinner of the Society will take place on the evening of May 21st, 1906. The date of the Annual Conversazione will be announced in due course.

Instructions for Intending Travellers. Details as to the Society's arrangements for instruction to intending travellers can be obtained by applying to the Secretary.

LEONARD DARWIN, } *Honorary*
JAMES F. HUGHES, } *Secretaries.*
J. SCOTT KELTIE, *Secretary.*

1 SAVILE ROW, LONDON, W.
October 1905.

The
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EXPLORATION AND SURVEY WITH THE TIBET FRONTIER COMMISSION, AND FROM GYANGTSE TO SIMLA VIÂ GARTOK.*

By Major C. H. D. RYDER, D.S.O., R.E.

I. The Main Expedition.

It has been said that the geographical results of the expedition to Lhasa have been disappointing. No one was better pleased than myself that this was in a sense true. Our knowledge of the country lying between our frontier and Lhasa depended chiefly on the surveys executed by different explorers trained by and working under the supervision of officers of my department—the Survey of India. They worked under extraordinary difficulties, and in great danger of their lives. That, when at last we have been able to carry through a regular and systematic survey of the country, we have not been able to find that the rough maps prepared from these explorers' surveys were in any important points other than very fairly accurate, reflects the very highest credit on these men, notably the late Pandit Nain Singh and the explorer A.-K., the latter of whom is still alive. In place of these rough maps, we have now an accurate survey of the country traversed by the expedition.

On September 24, 1903, I received orders at Bangalore to join the Tibet Frontier Commission at Kampa Dzong. Proceeding *viâ* Calcutta, where I had to spend a few days collecting instruments and kit, I arrived at Silliguri, the railway base, on October 3, and marched out the same afternoon to Sevoke, where the Teesta leaves the hills. This was not the time of year to see the Teesta valley at its best; very hot,

* Read at the Royal Geographical Society, May 15, 1905. Maps, p. 480.

raining nearly every day, the march up the valley was far from pleasant. The cart road, now open as far as Gangtok, was then constantly blocked by landslips, and very slippery. After Gangtok was passed the views of the snows should have been magnificent, but the higher hills were veiled in clouds. All the more pleasant, therefore, was the marked change once the frontier pass, the Kangra La, was crossed; clouds were left behind, and during the two months I stayed at Kampa Dzong we had nothing but the finest weather, with that wonderful clear atmosphere which every traveller in Tibet has remarked on.

Down the long slope from the Kangra La, and over the rolling downs near the valley of Giri, the great snowy range gradually opened out, till on reaching Kampa Dzong, or at any rate from the hill above it, one continuous line of snows was visible stretching from Chumolarhi to Mount Everest, a distance of some 150 miles. We were able to survey from this snowy range northwards to the Arun river—Tsangpo watershed, the Tibetans, beyond sending men to watch us, making no attempt to stop us surveying so long as we did not camp away from the mission post.

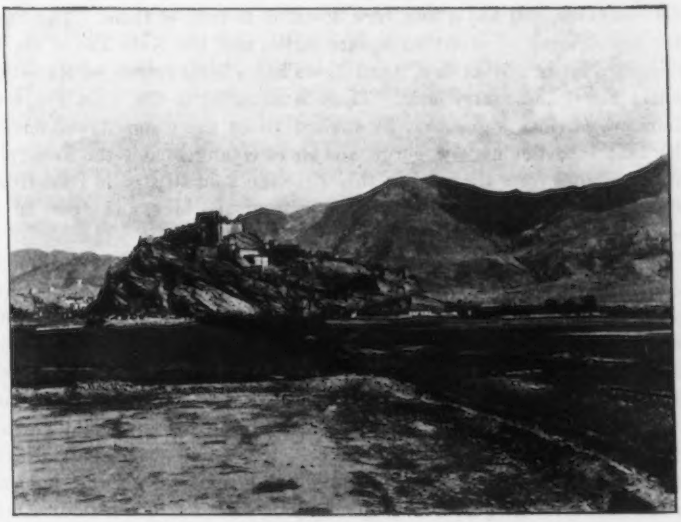
As regards the heights of peaks, our results were of a negative nature. The highest point on the above-named watershed was 20,100 feet; the two "very high snowy mountains" mentioned by Mr. Freshfield on p. 362 of the *Geographical Journal* for March, 1904, quoting from one of the explorers, were disappointing, being only 21,200 feet in height. The fine snowy range apparently running north from Everest, but in reality running north but some 30 miles east of Everest, has its highest summit at an elevation of 22,200 feet. In the photograph by Mr. Hayden (*R.G.S. Journal*, March, 1904), it will be noticed that the northern side (*i.e.* the right-hand one in the photograph) of Everest has a continuous slope, which I estimated at 7000 feet; and it is extremely unlikely that north of Everest, and hidden by the nearer snowy range (on the right edge of the photograph), the peaks could again rise to a height anywhere approaching that of Everest. It is interesting here to note that Everest, as viewed from Kampa Dzong, does not appear as the highest peak of a group, but as one massive summit standing by itself. Nowhere could we hear of any local name for Everest, although careful inquiries were made. The height of Kampa Dzong itself proved to be 15,200 feet instead of 13,800, as on previous maps.

Fortunately, just as we had completed all the surveying possible from Kampa Dzong under existing circumstances, it was decided that the mission should retire from Kampa Dzong and advance over the Dzelap La and up the Chumbi valley. We accordingly hurried across Sikhim and caught up the main body of the mission and its escort at Chumbi. This valley is disappointing; it has always had a great reputation, but we found it to be only 200 or 300 yards wide, and not very rich. The houses at Rin-chen-gong are good, but that is not due

to any richness in the valley itself, but to the fact that the Tomos, the inhabitants of the valley, have a monopoly of the carrying trade from Phari Dzong down into Sikhim.

A short halt here enabled me to get the lower end of the valley surveyed, and to detach Sub-Surveyor Dalbir Rai, who followed the valley down to the plains, and, returning to Gnatong by the adjoining valley, completed a most useful piece of work, including a hitherto unsurveyed portion of Bhutan.

The mission then moved up to Phari Dzong and over the Tang La (height 15,200 feet), a very easy pass to Tuna (height 14,800 feet).



GYANGTSE.

Here we spent the winter, and, except for some work in the Chumbi valley, surveying was nearly at a standstill; the Bhutan snowy range on the east, lower rounded hills on the west, and the Tibetan force at Guru, 6 miles north of us, limited our sphere of observation. The cold was intense, and a very unpleasant three months were spent before we again advanced. Towards the end of March Mr. Hayden, of the Geological Survey, and I, with an escort of twenty rifles, made a short excursion across the plain to explore the Lingshi La, a pass crossing the snowy range into Bhutan. Before, however, reaching this point, we were met by a small Tibetan force and requested to return. In view of my knowledge that Colonel Younghusband was very anxious to avoid, if possible, a collision with the Tibetans, I decided to retire to Tuna.

General Macdonald and the main force having arrived at Tuna, it was decided to make a preliminary advance to Guru, where the Tibetans were encamped, and establish a post there. Unfortunately for them, the Tibetans decided to oppose our advance. A short fight took place, in which the Tibetans suffered heavily. On April 2 Captain Cowie joined us, just in time for the advance to Gyangtse, which took place on April 4.

We camped on April 4 at Guru; we then marched round the shore of the Bam Tso to Chalu, and the following day did a short march down the narrow valley along which the stream flows connecting the Bam Tso with the Kala Tso. I ascended a point on the range between the two lakes, and had a fine view down on to both of them. The Bam Tso has an area of about 25 square miles, and the Kala Tso of about 15 square miles. Next day, April 7, we had a level march to Mangtsa, where the open country ends. There is no outlet to the Kala Tso, but there are obvious signs that in ancient times the water flowed out of the lake into the narrow gorge, and so to Gyangtse and the Tsangpo. About 8 miles from the lake in this direction a small stream rises from what is probably an underground flow from the lake, and flows in a broad and deep bed down the gorge.

From Mangtsa the force marched to 3 miles short of Kangma, down a narrow gorge, while Captain Cowie and I ascended the range to the east to a height of about 18,000 feet, to try and get a view ahead. In this we were not successful, still higher hills on the north on both sides of the gorge blocking our view. The Tibetans were reported by the mounted infantry to be in force holding a wall across the valley at Kangma; but next day their position, a strongly built wall, which, however, could have been easily turned, was found evacuated. Next day they were located in a position holding a narrow gorge known as the Red Idol gorge, and the precipitous hills on either side. Out of this they were easily turned by a direct attack and a long flanking climb on the part of the Gurkhas. We camped at Sapu that evening, and marched on to the Gyangtse plain the following day. On April 11 the dzong, or fort, of Gyangtse was surrendered by the Tibetans, who seemed cowed by the defeats they had received. The mission was established in a village on the right bank of the Nyang Chu, where there is a bridge, and about 1000 yards from the dzong.

A force under Colonel Brander was left as escort, while the General and the main force returned to the Chumbi valley, leaving posts at Kangma, Kala Tso, and other places on the line.

We now settled down to a peaceful existence. A bazaar was established outside the post, and officers in small parties could wander about the plain shooting.

Captain Cowie and I were then able to start triangulation off a measured base, and, with the help of three stations on the hills, were

able to complete all the work that was possible; but we were not then able to connect this triangulation with my Kampa Dzong and G.T. peaks, but we fixed some peaks on the Karo La range, which afterwards proved invaluable in connecting the Lhasa triangulation with this work.

Towards the end of the month a report came in that a force of Tibetans had collected on the Karo La, 45 miles from Gyangtse, on the road to Lhasa. A party, consisting of fifty men of the 32nd Pioneers and thirty mounted infantry, under Lieut. Hodgson, was sent out to verify this report. As this would afford an opportunity of getting in a good addition to our map, I decided to accompany the party with Captain Cowie.

We reached Ralung, two long marches from Gyangtse, on April 29, and the following day, accompanied by the mounted infantry, rode up to the pass, about 2 miles beyond which we saw the wall which the Tibetans had built. Lieut. Hodgson took a few men forward to draw their fire and make them disclose their strength. In this he was successful, and withdrawing his men without loss, although some Tibetans concealed on the hills above were rolling rocks down on him, we rode back to Ralung. I had intended taking the mounted infantry to Kangma in one long day's march, as it was important to have this route reconnoitred, but, owing to the presence of the Tibetans in such force on the Karo La, this was not now considered advisable, and we returned to Gyangtse in two marches, arriving there on May 2.

Colonel Brander decided to take out a force to turn the Tibetans out of their position on the Karo La, as they were threatening our line of communications. On May 3 he accordingly started, Captain Cowie again accompanying, as I hoped he might be able to get the route from Ralung to Kangma done this time. They attacked the Tibetans on the 6th, and drove them out of their position, but, owing to our having in the mean time been attacked at Gyangtse, Captain Cowie had to return with the force.

On the 4th everything at Gyangtse seemed peaceable. I had been out for a long day surveying on the hills to the south, and on my return heard of a report, originating from one of the patients in Captain Walton's civil hospital, that we were to be attacked next day. A small mounted infantry patrol went some miles down the Dongtse road, but found nobody. The Tibetan force, however, was at Dongtse itself, and, leaving when the moon rose about 1 a.m., attacked us just after dawn. Their attack was a complete surprise, but once our men turned out, the Tibetans were easily driven off with heavy loss. If, however, the Tibetans had not given the alarm by shouting and firing their guns, but rushed in with their swords, we should have been in a rather awkward position. Another force of theirs had in the mean time occupied the dzong, from whence they opened a heavy fire, which, to every one's surprise, more than reached our post. The fighting in and around

Gyangtse has been already often described; it culminated in the capture of the dzong on July 6.

Captain Cowie and Surveyor Sher Jang, who had come up with the relief force, now rejoined me, and on July 14 we commenced our march to Lhasa. Owing to the cloudy weather rendering triangulation impossible, I thought it advisable, in case we could not afterwards connect Lhasa and Gyangtse by triangulation, to run a subtense bar traverse; this entailed Captain Cowie and I being on the road all day, starting with the advance guard and getting in in the evening. The weather, too, was very bad, heavy rain falling almost every day, effectually dispelling the prevailing notion that this part of Tibet is a rainless country.

The Karo La (height 16,200 feet) was crossed on July 18, the bulk of the Tibetans holding the position bolting the night before from the wall in the valley, leaving their companions on the hills to their left to escape as best they could. They were easily driven out of their position by the 8th Gurkhas, who, however, established a record in hill fighting at high altitudes, the Tibetan position reaching an elevation of 18,500 feet, and their retreat leading across the face of a glacier.

The next day the force moved to Nangkartse Dzong, in sight of the Yamdrok Tso. The snow-peak marked in former maps in the centre of the promontory, round which the Yamdrok Tso makes an almost complete circle, is a myth. No hill there has permanent snow, though, as their height is about 17,000 feet, there doubtless is often snow lying there when there is none at Nangkartse Dzong, or on the shore of the lake (height 14,350 feet). After a day's halt we marched to Yarsik, where the original outlet of the lake obviously existed. We then marched for two more days along the shores of the lake, which all along this part is never more than 2 or 3 miles wide, and very often less.

We crossed the Kampa La (height 15,400 feet) on the 24th, an easy ascent from the lake-side, but a very long drop down to the Tsangpo. Owing to the low elevation (11,550 feet) and Sarat Chandra Das's description, I thought that the valley would have been well wooded; this, however, was not so: the hills were quite bare, and no trees grew wild, though round every village there were fine groves. We moved on 6 miles down the river to the place selected for the crossing, where the Tibetans had kindly left a large ferry boat on our side of the river.

The whole force had crossed on the 30th, a very laborious process. The valley here is broad and well cultivated, the river running in most places in several broad channels, with sandy islands in between. It was about at its highest flood-level soon after we had all crossed, with a very fast current and deep, and 140 yards wide.

On July 31 we moved off, and after a few miles turned up the Kyi Chu, a well-cultivated valley with a broad shallow river resembling the Tsang-po valley on a slightly smaller scale.

On August 2 we arrived at the Tolung Chu, a large affluent of the Kyi Chu, and over which there is quite a good bridge. From here we were rewarded by our first sight of the Potala, the residence of the Dalai Lama, situated on a small isolated hill overlooking Lhasa.

Next day camp was moved to within a mile of the Potala; this was, however, only a temporary camp, and, being swampy, another site was selected on drier ground north of the town, the mission being located in a very good house in pretty wooded grounds outside the town. The weather was not favourable for surveying—rain fell constantly, and

BRIDGE OVER THE NYANG CHU ADJOINING OUR POST, WITH GYANGTSE DZONG IN BACKGROUND.

heavy clouds lay on the surrounding hills—so Captain Cowie and I confined ourselves, after measuring a base, and observing a latitude and azimuth, to the survey of the town and suburbs of Lhasa on the scale of 6 inches to the mile. This took some time, as we were at first not allowed to enter the town itself; but later on, having got in all the somewhat extensive groves, gardens, and summer residences outside the town, we were allowed to march through the streets with an escort. In order to avoid attracting attention, for this portion of the work we did not use a plane-table, but made a compass and pace traverse from one fixed point outside through to another fixed point on the other side. The inhabitants showed some curiosity, but no hostility, at our proceedings. The height of the plain above sea-level is 11,830 feet. Captain Cowie left Lhasa on August 29 to return to Gyangtse, to try and secure the connection in the triangulation between that town and the points I had fixed from Kampa Dzong. The

weather now began to improve, and I was able to go out with a small escort, firstly, up the valley a day's march, from whence I took mounted infantry up to the junction of the Penbo Chu with the main valley, just opposite the Garden Monastery and some 30 miles from Lhasa; and, secondly, up the Tolung Chu, a somewhat similar expedition.

Having done these two trips, there only remained to go up on to the Penbo La, the pass on the main road leading north from and about 10 miles from Lhasa. This was important for the triangulation, and I was lucky to do all that was necessary in a short spell of fine weather, which just coincided with the five days I spent in camp at the foot of the pass, climbing an 18,000-feet hill each day.

From this range we were able to sketch in carefully the adjoining valley to the north, a broad, well-cultivated, and thickly populated plain; and from three stations I was able to connect on with the peaks of the Karo La range, and also to fix many points north and eastwards, including some fine snow-peaks south of the Tengri Nor, mentioned by Mr. Littledale, the highest of which was 23,250 feet in height, and the highest peak we ever came across north of the Tsangpo. Two other snow-peaks which I fixed are, I believe, those mentioned by M. Bonvalot, and christened by him Mount Huc and Mount Gabet; but their heights were disappointing, the highest being 21,500 feet.

The treaty had been formally signed at the Potala on September 7, and on the 23rd we left on our return march. On this occasion we recrossed the Tsangpo 10 miles higher up, and crossed the range between it and the Yamdrok Tso by the Do La, 16,000 feet, a long steep climb from the river. From this pass, the weather being clear, I had a fine view, and was able to fix a station by observations to peaks on the Karo La range and to two Bhutan peaks, already fixed from India, being also able to see and observe to one of my stations on the hills north of Lhasa. I had gone on ahead of the main force, with an escort of one hundred Gurkhas under Major Row. Next day we marched along the lake to Yasik, and I went up on to the range again, and, observing from two more stations, completed a good area of triangulation, and secured the required connection between the triangulation done from Gyang-tse and that done at Lhasa.

At Yasik on September 30 we met Captain Cowie, who, though much hampered by the cloudy weather, had effected a satisfactory connection between the Gyangtse triangulation and the Kampa Dzong work. We here struck off the main route up the side valley, across a very low, in fact almost inappreciable, watershed, and followed down the narrow valley known lower down as the Rong Chu, which flows into Tsangpo. I have no doubt whatever that this is the old outlet of the Yamdrok Tso, which now is land-locked Next day we left the valley, camping near the Nyadong La, crossed the pass next day (height 16,000

feet), and so on to the plain above Ralung. This survey was useful, in that it showed the possibility of turning the Karo La. Captain Cowie then made a round from Ralung into the Niru valley, down to Gobshi, and so to Gyangtse, while I caught the general up on the main road, and accompanied the main force. I now made arrangements for Captain Cowie to complete the work remaining between here and Chumbi, on which he writes as follows :—

"On October 8, with Sub-Surveyor Hazrat Ali and a portion of the survey detachment, I left Gyangtse for Kangma, which was reached next day. Commencing a route-survey from this village on the 10th, we struck off the line of communications, marching eastwards through a narrow defile in the bare rocky hills dividing the waters of the

THE CROSSING OF THE TSANGPO OR BRAHMAPUTRA.

Nyang Chu and the Niru Chu. As far as the Nilung La, which we crossed the same day, we followed the track which is part of the main road from Kangma to Ralung *viâ* the Wogya La. After crossing this pass and descending into the open plain, which receives the headwaters of the Niru Chu, we turned southwards, heading for the Rham Tso. Passing over the low rolling hills which intervened, we reached the lake on October 14, completing the survey of this locality, and fixing the position of the Yu Tso, a lake lying at the foot of the snowfields of the big range, culminating further to the south-west in Chumolhari. On the 14th I got into communication with the headquarters staff, who had just reached Kala Tso, and, for the purpose of adding to the half-inch survey of the Khambu valley, obtained sanction to strike off the line of communication at Tuna, and, crossing a pass some 12 miles west of the Tang La, to follow the course of Khambu Chu, eventually rejoining the line at Chumbi.

"Surveyor Shar Jeng, who had accompanied the force from Gyangtse as far as Kala Tso, joined me at Chalu on the 14th. On the 16th we

left Tuna, taking with us from there a Tibetan who professed to know the hills to the east of Powhanri, and camped in the small valley below the pass.

"On the evening of the 16th snow began to fall, and by the 17th and 18th a severe blizzard had set in. We left camp on the 17th in the midst of it, purposing to cross over into the Khambu valley, but were unable to reach even the pass. In consequence of mist and the thick driving snow, it was impossible to see more than a few yards in any direction; we had no track to guide us, and the snow was nowhere less than 2 feet deep. The difficulties of progressing were great, and in addition we, the guide included, lost our way. Though only a few of the party were frost-bitten, many had begun to suffer from snow-blindness. Finding it impossible to proceed, with much trouble we eventually got back on the 18th to a point near our camping-ground of the 16th. Next day, with over 50 per cent. of the party incapable from snow-blindness, we crossed the Tang La and reached Phari in the evening. On the 22nd I reached Chumbi, and reported to the G.O.C. (the telegraph line having been broken by the storm), who had sent out a search party for us from Chumbi.

"All of the party had recovered from snow-blindness and the effects of exposure sufficiently to move to Chumbi on the 26th. The whole of the survey detachment left Chumbi on the 28th, and, marching *viâ* the Nathu La and Gangtok, reached Siliguri on November 5."

The survey results of the expedition are as follows:—

Triangulation.—An area of 45,000 square miles was completed, connecting Lhasa with India, and fixing all prominent peaks which were visible, with their heights.

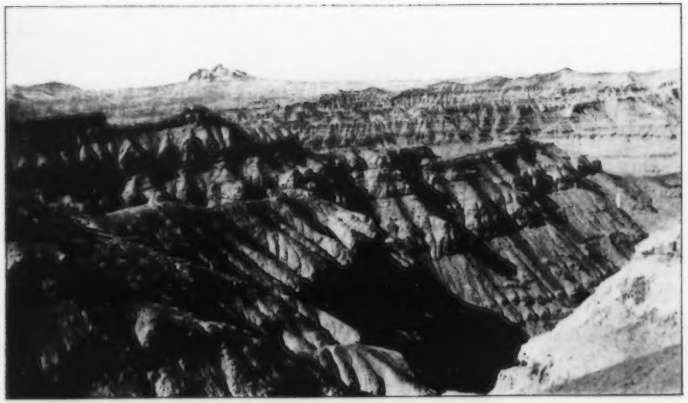
Topography.—An area of 17,000 miles was surveyed on the scale of 4 miles to the inch, of which 3000 square miles, in the neighbourhood of the Chumbi valley, Gyangtse, and Lhasa, were also surveyed on the scale of 2 miles to the inch.

Route surveys, on the scale of 1 inch to the mile, were made of the road to Lhasa.

Large-scale plans were also made of the towns of Gyangtse and Lhasa.

II. From Gyangtse to Simla viâ Gartok.

When the treaty was signed at Lhasa on September 7, 1904, it was decided that a party should proceed to Gartok to examine the place, as it was one of the trade marts which the Lhasa Government had decided should be opened in Tibet. It was obvious that this would afford a great opportunity of adding to our geographical knowledge of the country. The ostensible object of the journey being a political outcome of the treaty, Captain Rawling, of the Somersetshire Light Infantry, who in 1903 had made a remarkable and useful journey in Western Tibet, and



ERODED HILLS OF THE SUTLEJ VALLEY.

CHUMIUMO, OVERLOOKING PASS TO KAMPA DZONG.

Photograph by H. H. Hayden.

CHUMOLARHI (to the right) AND SNOWY RANGE AS VIEWED FROM TUNA.

Photograph by H. H. Hayden.

who was now deputed to open the trade mart at Gartok, was placed in general control of the expedition. He was assisted by Lieut. Bailey, 32nd Pioneers, one of the few officers who have acquired a knowledge of the Tibetan language, which proved very useful to us; the survey party consisting, besides myself, of Captain H. Wood, R.E., and Sub-Surveyor Ram Singh, R.S.

In making our arrangements for the journey, two considerations were paramount—firstly, that we should be having a race against winter, with a possibility that, should we be unable to get over the passes into India before the winter snow fell, the unpleasant prospect would have to be faced of having to winter at Gartok or some equally cold and inhospitable spot; secondly, it was quite impossible to tell whether and to what extent the Tibetans would assist us. Fighting had only lately ceased, the treaty had been signed barely a month previously, and there had been no opportunity of seeing whether the Tibetans would adhere to the treaty when our troops were withdrawn to India.

Our time for preparation was very short, every day's delay increasing the probability of our being snowed up. Captain Wood and Lieut. Bailey arrived at Gyangtse, which was to be our starting-point, on September 30, while Captain Rawling and I only reached the same place on October 6 and 5 respectively.

Our transport we organized as follows: twenty-six baggage ponies to give us a nucleus of our own, should the Tibetans make difficulties about providing us with animals; seventeen riding ponies, it being important that, in view of long and continuous marching at a high elevation, as many men as possible should be mounted; one hundred yaks were lent to us from one of the transport yak corps to take us to Shigatse, but not to go beyond that town. From there onwards, however, the Tibetans invariably, and without any demur, provided us with whatever transport we required. Ponies, donkeys, mules, yaks, and coolies at various times carried our baggage, and, although it was difficult to supervise so large and mixed a caravan, no single article was lost during the whole time the journey lasted.

We took two months' supplies for all our men, with two months' extra of such things as ghi, goor, etc., which could not be obtained *en route*; while for the officers' mess we took four months' stores. Meat we could rely on obtaining in abundance, and tsamba or parched barley flour, as long as we came across villages.

Our party was finally organized and ready to start on October 9 as follows:—

Captain C. G. Rawling, Somersetshire Light Infantry; Captain C. H. D. Ryder, R.E., Survey of India; Captain H. Wood, R.E., Survey of India; Lieut. F. M. Bailey, 32nd Pioneers; Sub-Surveyor Ram Singh, R.S.; hospital assistant Hira Singh; three military surveyors; five

sepoys of the 8th Gurkha Rifles; five survey Khalassies; seven pony-drivers; two Hindustani servants; two Tibetan servants; Mahomed Isa, a Ladakhi, who acted as caravan leader; and last, but not least, a very small Lhasa Blenheim spaniel, who followed our fortunes throughout.

In order to have the advantage of the company of Captain O'Connor, who was remaining as trade agent at Gyangtse, and who, with two other officers, was making a trip to Shigatse, we postponed our departure till the 10th.

Our first day's march took us to Dongtse, the late headquarters and supply depôt of the Tibetan army which had attacked the mission and its escort for two long months at Gyangtse; but here, like everywhere else, we were cordially received—mainly, I fancy, owing to our being accompanied by a Lhasa official, who had been deputed to escort us to Gartok, and also to our being supplied with a very strongly worded permit signed with the seals of the Lhasa Government and of the three great Lhasa monasteries, and directing all officials along the route to render every assistance.

Three more marches, following the valley of the Nyang Chu, which is one of the richest and most prosperous valleys of Tibet, landed us at Shigatse on October 14. Here we spent several busy days with an army of tailors, making warm clothing for ourselves and our men, lining all coats with lambskins, making fur caps and gloves, etc., till finally, when fitted out, we presented an appearance akin to Arctic explorers. Our stay at Shigatse was not, however, all work. We paid a most interesting visit to the great Tashi Lhunpo monastery, where the monks received us most cordially, showing us all over the place, and finally giving us refreshments of tea, cakes, and dried fruits. This monastery is said to contain four thousand monks, and although not so large as, is richer than, the great Lhasa monasteries. The bulk of the buildings, the residences of the monks, were of the usual type—narrow paved roads with high houses on each side, dirty, and not picturesque; but we also enjoyed the sight of the tombs of the five previous Tashi lamas, each a separate building with its golden roof and highly ornamented interior, filled with a wealth of turquoises, gold bowls, and rare old jade and cloisonné, the effect being somewhat marred by a foreground of small vessels holding lighted tapers fed by very evil-smelling butter. Bogle's description of his visit is very picturesque and accurate; the number of tombs has now, however, increased from three as seen by him to five as seen by us.

We were fortunate, also, in being received by the Tashi Lama, who, after holding an almost co-equal position to the Dalai Lama, has now, by the deposition of the latter, become the most important ecclesiastic in Tibet. He was living in his summer residence, a house outside the town, to which, with Captain O'Connor as political officer at our head, we proceeded. A little hitch occurred at the gateway, as an arch-

scoundrel, Colonel Ma, who had been the Chinese official at Gyangtse when we were attacked, and had never given us warning, nor even tried to protect the servants and property of his colleague Captain Parr, was also paying a visit. Captain O'Connor refused to enter the house while this individual was in it, and the latter had to be smuggled out by some back door. We were then shown up some steps and along dark passages till we arrived at the reception-room, at the far end of which we could see the Tashi Lama seated cross-legged on cushions on a raised platform. He received us each with a bow and a smile, which we returned, and were shown to seats on one side of the room, while the other side was filled with Tibetan officials and monks in either the ordinary maroon-coloured clothes usually worn

A MAIN STREET IN LHASA.

by monks, or in the yellow silk of the higher temporal officers. Tea, undrinkable as usual, was handed round, but on this occasion it had a certain glamour attached, due to its being served in enormous teapots of gold and silver. Dishes laden with sweetmeats and dried fruits were also brought in, but soon hurriedly removed and handed over to our followers.

While Captain O'Connor was exchanging civilities with the Tashi Lama, we had time to think of the sudden change from a few months before, when the Tibetans, amongst whom was a strong contingent from this very place Shigatse, were attacking us at Gyangtse, to the present moment, when we, a few unarmed officers, were sitting in amity with our quondam enemies. The Tashi Lama himself is an interesting personality; sixth holder of the office, his face is one that would not pass unnoticed anywhere, still less in Tibet. He has clear-cut features,

high cheek-bones, and a pale complexion; his quiet, dignified manner made a lasting impression on us. His age is only about twenty-three, and he seemed generally beloved and revered. During the whole of our visit a slight and pleasant smile never left his face. After silk scarves had been presented to us and our Tibetan followers had been blessed, we left, with the feeling, due partly to the personality of the Lama himself, partly to the room with its dim light, that we had been assisting at some religious ceremony.

We had commenced our survey at Dongtse, one march from Gyangtse, and as we wished to keep up triangulation, Captain Wood and I left Shigatse on October 17 to do two short marches, the rest of the party leaving a day later and doing the two marches in one. Owing to bad weather, which gave us some rain and covered the surrounding hills with snow, we were unable to reach our hill, so decided to halt a day at Kangjen Gompa, a most delightful camp in a grove of trees. This was the same storm which entailed such hardships on our force returning to India in the neighbourhood of Phari Dzong. Fortunately for us, we were here at the lowest point of our journey, the height of Shigatse being 12,570 feet, and escaped with only slight inconvenience.

By visiting these hills, one of which was over 18,500 feet in height, and from two of which we had fine views of Mount Everest, Captain Wood was enabled to carry on the triangulation under very adverse circumstances. To climb one of these hills is itself a hard piece of work; to observe at the top in a bitter wind is one of the most physically painful operations I have ever experienced. To do this in combination with a day's march leads to a very long and hard day's work. Captain Wood carried this on for days and months with hardly any intermission—a feat which could only have been accomplished by an officer of his energy and determination.

Until we reached Pindzoling, on October 22, the river had been a few miles to the north of our route, but from thence we followed the river more closely. Two more marches and we were at Lhatse Dzong; a dzong or fort on a small rocky hill, very similar to those at Shigatse and Gyangtse, surrounded on one side by the river and on the others by a fair-sized monastery and a small town. The valley here widens out into a plain, cultivated in parts, barren elsewhere. At Lhatse Dzong we halted a day, which enabled Captain Wood and I to ascend a hill a few miles east of the town, overlooking a broad bare valley which leads to the very famous Sakya monastery. We regretted that want of time, and the consideration that it was not advisable to divide into two parties until we had thoroughly tested the friendly disposition of the Tibetans, had prevented us from paying a visit to this monastery.

From Lhatse, however, the Tibetans having shown no desire but to assist us in every way, we decided to separate. While Captain Wood and Lieut. Bailey followed the main route, which here crosses and

leaves the river, Captain Rawling and I stuck to a route reported to follow up the south bank, as I did not wish, if possible, to omit any portion of the river from our survey.

Accordingly, on the 26th we parted company, camping that night on opposite sides of the valley, which now closed in. We kept to the river the following day, but on the 28th we had to leave it, and for two marches followed up a side stream, the Chi Chu, running parallel to and only 2 or 3 miles distant from the Tsangpo, which we again rejoined on the 30th. On November 1 we could see that the river ran between rocky hills with snow-peaks on either side, and had to leave it, making a wide *détour* to the south. We marched up

BIRD'S-EYE VIEW (LOOKING DOWN VALLEY) OF CHI CHU VALLEY FROM HILL ABOVE DABONG. DABONG IN RIGHT-HAND CORNER.

a side nullah, camping in bitter cold at nearly 16,000 feet, and crossing the Kura La, a very desolate pass, next day, at an elevation of 17,900 feet; marching across the head of a plain which forms the headwaters of the Chi Chu, previously mentioned, we passed over an almost imperceptible watershed down a narrow stony valley to the village of Kaju. We had had a magnificent view from a hill a few hundred feet above the pass of the main Himalayan range. Mount Everest stood up towering above the rest of the range in its neighbourhood in one isolated peak, a continuous drop of some 8000 feet separating it from the rest of the range east and west of it. The village of Kaju (14,800 feet) lies on the edge of the Sutso Tang plain, which takes its

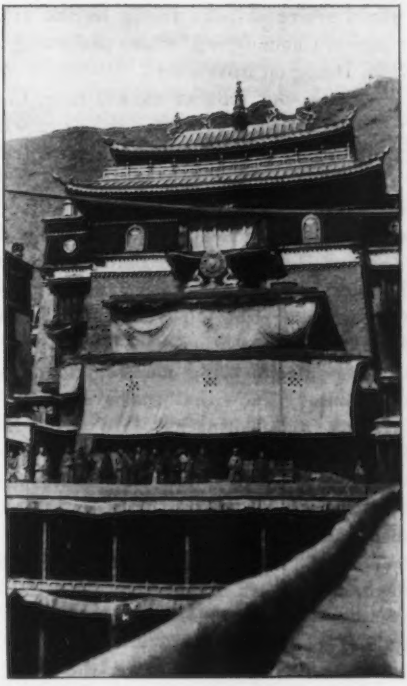
name from an old ruined fort on a small eminence in its centre. It is here about 5 miles wide, and we could see it trending away southwards and joining the Dingri maidan, which lies north of Mount Everest. A day's halt here enabled me to cross this plain, from the hills on the western side of which I obtained an uninterrupted view of Mount Everest, no hills intervening. I was thus able to satisfactorily establish the fact, which I had suspected a year before at Kampa Dzong, that no peaks anywhere approaching the height of Everest exist to the north of it or anywhere in its neighbourhood; it stands alone in its magnificent solitude, and is entirely disconnected from the mass, to the west of which Peak XX. (Gaurisankar) is the best-known point. On the south-east of Everest, but separated from it by a low gap, lies Peak XIII. (Makalu). We were here in the valley of the western branch of the Arun or Kosi river, but, recrossing the watershed next day by the Sheru La (17,600 feet), we once more reached the banks of the Tsangpo on November 5. The scenery was now changing; trees we had said good-bye to some marches back, our last cultivation we passed that day, while the hills were becoming more open and the plains abounded in sand-dunes. Brushwood was in places available for fuel, but we preferred argol, or dried yak-dung, as it gave greater heat, and, if the fire was carefully looked after, less smoke. During the whole of this portion of the river journey we had seen no four-footed game other than numerous hares, and a few gazelle on the Sutso Tang plain, but birds we saw and shot numbers of, Tibetan partridge, ramchikor, and Tibetan sand-grouse giving us a welcome change in our otherwise monotonous fare of mutton.

On the 6th we crossed to the north bank of the river with the utmost difficulty; a crazy-looking punt, manned by lamas, took us across in detachments, but, owing to the masses of floating ice whirled down the river by the rapid current, the punt was repeatedly forced back, and only reached the opposite shore after floating down some 400 yards, the operation of hauling the boat up again to its original starting-point against the ice being very hard work. On the 9th we arrived at Saka Dzong, a small village, and found that Captain Wood's party had reached there two days previously. We gave ourselves another day's halt here, as there was a good deal of surveying to be done in the neighbourhood.

Captain Wood writes as follows, regarding his journey:—

"Leaving Lhatse on October 26, we crossed the Tsangpo about half a mile below the town. A couple of boats had been collected by the Tibetans for ferrying across our kit and transport, but the process was very much shortened by the discovery of a ford about a quarter of a mile up-stream, by which the ponies were able to cross. After keeping to the north bank for about 10 miles, we turned up a side nullah and camped at Sanggelung village; following this nullah next day for a

short distance, we crossed by an easy pass into a country the drainage of which led into a succession of small lakes, whose surfaces were covered with geese and duck. On the largest of these, the Ngap-ring Tso, a tasam, or stage-house, is situated, which place we reached on the 27th; and, hearing that no grain would be procurable until we reached Barkha, on the Mansarowar lake, we bought all we could procure, but even this would only give our ponies a couple of pounds daily. The next day we passed Ralung, the last place we saw cultivation. Every day now found us at a higher altitude, as we were marching more or less along the watershed between the Tsangpo and its large tributary, the Raga Tsangpo. The valley of this latter stream is narrow, running almost due east and west, parallel to and about 30 miles to the north of the main river. Into this distance is crammed a tangled mass of hills, whose crests average about 18,500 feet, with several peaks of about 22,000 feet, covered with permanent snow. This part of our march was exceptionally unpleasant, as the wind on the hills never dropped by day below hurricane force, and, camping at elevations up to 16,100 feet, the change in temperature from the comparatively warm valley of the Tsangpo was most noticeable. The hills, clothed with a coarse grass on their lower slopes, but quite bare above 17,000 feet, were, as a rule, easy to climb; and from the summits lovely views of the Himalayas were obtained, Makalu and Everest, both standing out as great isolated peaks, being particularly imposing. The tasams, at which every four or five days we changed our yaks for fresh ones, were the only signs of habitations we met with, and these, as a rule, consisted of tents, with a mud hut or two. The marches were all long and wearisome in their monotony, and, owing to the narrowness of the



TOMB OF ONE OF THE TASHI LAMAS. TASHI LHUMPO MONASTERY.

valley, Ram Singh and I, to carry on the survey, had to climb to the crests of the range every day, seldom getting into camp before sunset, and on one or two occasions not arriving before nine or ten at night. On November 5 we crossed the Ku La (16,700 feet), situated at the headwaters of the Raga Tsangpo, and by a steep descent dropped into the valley of a small stream draining into the Tsangpo. At that night's camp we received letters from Captain Ryder, saying that he would arrive at Saka Dzong on the 9th. Passing under the snowy range of Chour Dzong, whose peaks range up to 21,000 feet, we reached Saka Dzong on November 7."

During our halt at Saka Dzong, Captain Wood ascended a high peak to the north (19,300 feet), from which he had a fine view north up the valley of the Chata Tsangpo, a tributary of the main river.

Saka Dzong has only a dozen or so houses, very dirty, the neighbourhood (height 15,150 feet) being, like that of every Tibetan village, a dust and refuse heap. We left on November 11, again in two parties. This time Lieut. Bailey accompanied me back to the river, while Captains Rawling and Wood followed the main route. That day we forded the Charta Tsangpo, a fair-sized affluent of the main river, and, crossing some low hills, reached the Tsangpo on the 12th, crossing the same evening late, it being necessary to do so then, as from my previous experience I knew that the river would be nearly impassable in the morning from floating ice. We crossed in a small skin-boat, our animals fording higher up. For several days we marched up-stream in a broad valley covered with low sand-dunes and stones, with a very small quantity of poor-looking grass, on which, however, kyang and gazelle seemed to thrive. The track followed by the Pandit Nain Singh, as he marched up from Nepal to Tradom in 1865, joined in on our left, but in these plains in Tibet it is difficult to find any signs of a path, as every caravan meanders over the plain without keeping to any defined track.

We recrossed the river on the 16th; but now it was completely frozen over, and we crossed on the ice, the only thing necessary being to make a good track for the animals by throwing some earth down on the ice. That evening we arrived at Tradom, where we found the rest of the party had arrived on the 14th. The weather had been taking a turn for the worse: low temperatures at night we always had, cold winds in the day were the rule; but if the days were sunny, a little walking would soon make us warm. When the days were cloudy, however, there was nothing to counteract the cold, and a march was a most miserable performance.

Captain Wood writes: "On leaving Saka Dzong, our party kept down the valley till we reached the Chata Tsangpo, which we found no difficulty in crossing. The stream was at that time some 100 feet in width, with a depth of 2 feet, flowing in one channel, having just left

a very deep narrow valley to emerge into a plain of about 3 miles in width. Striking up a small side nullah, we followed it for 5 miles, and camped at the foot of the Lalung La. On this pass we first saw signs of *Ovis Ammon*, and from the information we received, this appears to be the eastern limit of their country along the road we had traversed. The road for the next three days—if it can be called a road—was the worst we met with, and consisted of large broken rocks set in deep sand; and to make us even more uncomfortable, the weather changed to snow, accompanied, as usual, by a howling gale of wind. Inhospitable as Tradom appeared to us when we first descried it, we hurried on as fast as our ponies would take us, to get within the shelter of its single stone house, where we might warm our frozen limbs over a yak-dung fire, and pity the remainder of our party, who had still another two days to endure before they could hope to join us."

Tradom did not tempt us to halt; it is a desolate spot, with a small monastery on the hill above, inhabited by only three or four monks, but from the hills to the north we had a fine view of a snowy range reaching an elevation of 23,200 feet. We accordingly left the next day, and, marching across the plain all day, camped amongst the hills on the far side. This plain is full of small ponds lying among sand-dunes, and there was an unpleasant tributary or two to cross, the water frozen at the edges for 4 or 5 yards, then a drop of 3 feet into icy-cold water full of floating ice, ending with a scramble out on the other side on to ice again.

We now followed the river valley for a week or so, always in the same large plains, until we could see the watershed range ahead of us, from the valleys of which innumerable streams issue to form the Tsangpo, the largest coming from a snowy range to the south-west. After enjoying some days of bright sunshine, the weather again took a turn for the worse, and we crossed the Mayum La (height 16,900 feet) on November 26, with a foot or two of snow on the ground. We had now finished with the Tsangpo, having surveyed it from Shigatse to its source. Our next point of interest was to be the lake region ahead of us. The day after crossing the Mayum La we camped on the northern shore of the Gunchu Tso, a lake 11 miles long by 2 or 3 miles broad, with an area of 22 square miles, completely frozen over, and having no outlet at all. Several *Ovis Hodgsonii* (*ammon*) had been shot before reaching the Mayum La, and we now came on large herds of Tibetan antelope, of whom we each shot several, and could have shot many more if we had wished, as they were very tame.

Crossing several low passes and generally undulating ground, we came in sight of the Mansarowar lake (Tibetan Tso Mobang) on November 30. The lake is neither impressive nor beautiful, like, say, the Yamdrok Tso, passed on the way to Lhasa. It was not frozen

over, except for 100 yards or so round the edge; the water was fresh, and our surveyor, Ram Singh, on account of its sanctity, bottled some and carried it back with him to his home in Dehra Dun. Skirting the lake, we rode across the low hills, which close in on the western side, to look for the outlet, which Moorcroft had not been able to find, which Strachey had found, and which Mr. Savage Landor had claimed to have proved did not exist. We struck the channel a mile below the outlet, a small stream only partly frozen over; this we followed up, and found that it did not flow from the lake, but from a hot spring, at which we found and shot some mallard. We then followed up the dry nullah to the lake, and proved that Strachey was, as was to be expected, quite correct. No water was flowing at this time of year, but the local Tibetans all agreed that for some months in each year there was a flow during the rainy season and the melting of the snows, *i.e.* about from June to September. As a rise of about 2 feet in the level of the lake would cause water to flow down the channel, this appears quite worthy of belief. The length of the channel between the two lakes is about 3 miles. That day, December 2, we reached a Tibetan stage-house, and next day had a long day's ride to try and discover an outlet for the second lake, the Rakas Tal, or Tibetan Lagang Tso. This lake is very dissimilar to the Mansarowar in shape, and was entirely frozen over. The latter is about the same width, 12 miles north and south, as it is east and west, with an area of 110 square miles; the former is a long narrow lake running north and south, some 16 miles long by 3 or 4 miles wide, with an area of about 55 square miles.

It is the sacred character of the Mansarowar lake rather than its size which has made it well known; its height above sea-level is 14,900 feet. We found an old stream-bed issuing from the Rakas Tal, but every Tibetan we asked told the same story—that no water ever flowed along it now, but that in days gone by, one man saying before the Sikh war, water did flow out of the lake and down this channel. We followed it down for some 6 miles along the plain, and could find none of the ordinary signs that water flowed down it until we reached some low hills; here evidently, from the lie of the sand, water flowed at some time of the year, and away from the lake. The lakes being now entirely disconnected at all times of the year from the Sutlej river, the sources of that river must lie in the hills on either side of the valley and west of the lake region.

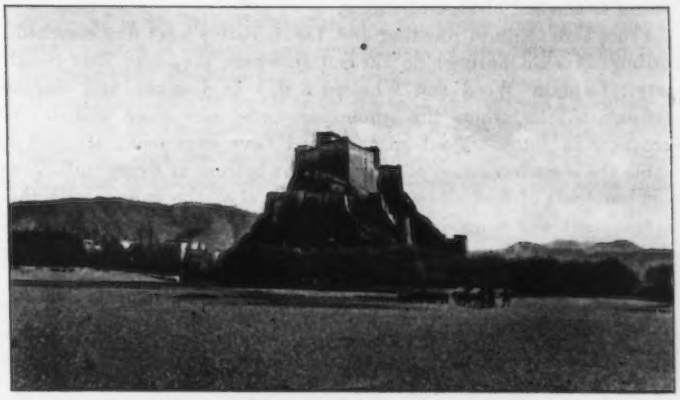
The Kailas peak was very prominent on the hills to the north, snow-covered, 21,800 feet in height. The strata forming the mountain are horizontal, which gives it a peculiar appearance; from the side we saw it, the top was quite inaccessible. There are several monasteries on the path which pilgrims follow in circumambulating the mountain. A very fine snow-mass, culminating in a peak over 25,000 in height, Mémo or Gurla Mandhata lies to the south of the Mansarowar

MANSAROWAR LAKE.

CHANNEL CONNECTING THE MANSAROWAR WITH
THE RAKAS TAL LAKE.

lake. A low watershed south-west of the lake leads to Purang or Takla Kot.

Keeping to the north side of the broad open valley in which the Sutlej flows, we arrived at another stage, Menzé or Missar, on December 5. Here we divided, sending our heavy baggage down the valley with Ram Singh, as I wanted him to continue the survey of the Sutlej valley while we went into Gartok. We were pleasantly surprised to find the Jerko La, the pass on the Sutlej-Indus watershed, low and easy (height 16,200 feet), and without difficulty reached Gartok (height 15,100 feet) on the 9th. This is the summer residence, Garyarsa; the two Garpons, the joint governors of Western Tibet, were



LHATSE DZONG, THE LAST LARGE VILLAGE EN ROUTE FROM SHIGATSE TO GARTOK.

residing at Gargunsa, the winter residence, some 30 miles down the valley, but had come up to receive us.

We only halted one day at Gartok; in that time we had seen more than enough of it. We were unanimous in looking on it as one of the most dreary inhabited places we had struck in our journey—a long broad plain, absolutely bare, with a dozen wretched hovels in the middle, constitutes at this time of year what is in summer the chief trading centre of Western Tibet; but in summer traders are said to collect in large numbers, living in tents. The wind howled round the hut we were in continuously, and, the weather looking threatening, we were not anxious to stay a minute longer than was necessary for Captain Rawling to settle up trade questions with the Garpons. Having now accomplished the main object of our journey, it only remained for us to get back into India as soon as possible. Fortune had favoured us so far, but we had some high passes to cross. The

first of these was the Ayi La, height 18,700 feet. Two marches took us to near the top of the pass, encountering a blizzard the second day. That evening we saw the only herd of wild yak we had come across in our journey. Crossing the pass next day was no easy matter; the ascent was gradual, but there were 2 feet of snow on the ground, and a bitterly cold wind was blowing. It was with the utmost difficulty that, under some shelter from a rock, I took boiling-point observations, and with a sigh of relief hurried down the other side. One of our chief obstacles was surmounted. It began snowing on the pass that evening, so we had only just crossed in the nick of time. At Dunkar (14,100 feet), where we camped that night, we met cultivation for the first time, and it was a pleasant sensation to feel that we were gradually coming to the end of high altitudes.

From here Captain Rawling and Lieut. Bailey next day marched to Totling (Tibetan Tuling), on the Sutlej, where they met Ram Singh's party. Captain Wood and I halted a day at Dunkar, and marched next day to Tibu, where the whole party was once more united. We were now in the most cut-up country I have ever seen; it must resemble the loess formation of China. The bottom of every nullah was some hundreds of feet below the general level of the valley, with their edges so cut and worn into fantastic shapes that it was difficult to believe that one was not looking on the ruins of old castles. There are also innumerable caves, in which the inhabitants live.

On December 16, at Kyinipuk, we met Thakur Jai Chand, who had been sent up to be our trade agent at Gartok. He brought with him some very welcome newspapers. I must own we none of us envied him his job for the winter.

Each day's march now consisted of climbing up out of a deep nullah and down again into the next. We crossed the Shiring La (16,400 feet) on the 21st, in deep snow, with great difficulty, the descent on the western side being very bad going. Next day we camped at Tyak, on the Sutlej, which had been flowing on the left of our route only a few miles distant, but invisible to us owing to its being at the bottom of a deep gorge. On the 23rd we marched to Shipki, crossing the river on the ice, elevation 9300 feet. On Christmas Eve we surmounted our last obstacle, the Shipki La on the frontier—a climb of 5000 feet, mostly in snow, and a drop of 6000 feet on the other side, camping at Khab, in British territory. From here we had eighteen marches into Simla, finding bungalows at every stage on and after December 28, finally arriving at Simla on January 11.

The area we surveyed with the plane-table comes to about 40,000 square miles. We surveyed the Tsangpo from Shigatse to its source, surveyed the Mansarowar lake region, and settled the doubtful points connected with it, which have been the subject of much discussion; we completed the survey of the Sutlej river from its source to where it

enters British territory, and surveyed the source of the Gartok branch of the Indus.

The triangulation, which is still under computation, was invaluable to correcting the plane-table work and fixing many heights.

The cold we had to contend against was at times very severe; the lowest minimum we recorded was −24° Fahr., but as the thermometer always registers its lowest on clear, still nights, it is not a good guide. It may be generally said that when the air was still the cold was quite endurable, and on sunny days, out of the wind, no climate could have been pleasanter. When, however, the wind blew, which, I am sorry to say, was generally the case, no clothing ever invented was sufficient to keep one warm. When a hurricane occurred on a cloudy day, our surveying was done with lightning rapidity, our great object being to hurry on to the friendly shelter afforded us by our tents; but the constant change of scenery, and the interest of our journey, did much to counteract the discomforts we met with.

My companions will agree with me that the success attending our journey was in the first place due to the friendly attitude of the Tibetans, induced by the cordial relations which Sir Frank Younghusband had established with the Lhasa Government. We were indeed glad to be able, by only two or three months' hard work on our part, to prove that the treaty signed at Lhasa was not merely a paper one, as might so easily have been the case, but that it inaugurated an era of truly friendly relations between ourselves and the Tibetans.

I am greatly indebted to my companions, Captain Rawling and Lieut. Bailey, for the ready assistance and hard work they underwent in furthering the survey work, in which Captain Wood and our native surveyor, Ram Singh, proved themselves sterling workers.

NOTE.—The lecture was illustrated by lantern slides from photographs taken by Mr. J. C. White, Mr. H. H. Hayden, Captain C. G. Rawling, and the lecturer.

Before the paper, the PRESIDENT said: We have to welcome this evening Major Ryder, on his return from a most important and interesting journey in Tibet. I need not introduce Major Ryder to the meeting, because he is an old friend, and most of you will remember the interesting paper he read a little more than three years ago on the subject of his survey with Major Davis in Yunnan. I call upon Major Ryder to read his paper.

After the paper, Sir FRANK YOUNGHUSBAND: Major Ryder has very gracefully acknowledged that the success of his expedition was due to the friendly relations which I, and he might have added which General Macdonald and every officer and man in the force, was able to establish with the Tibetans, and that is all the more satisfactory because it was no part of the treaty that this expedition should take place from Shigatse to Gartok. It is, however, only a contributory factor to the success of the expedition, and the expedition would never have taken place at all if the idea had not originated in the fertile brain of Mr. Louis Dane, the Secretary of the Government of India, in the Foreign Department. He it was who first put this idea into my head, and after I had thought it over and

considered the *pros* and *cons*, I put it to the Tibetan Government, and was able to obtain from them consent for it to be undertaken. However, even then, with the idea originated and with the approval of the Tibetan Government, little would have come of it if we had not been able to obtain the services of really efficient agents, and, fortunately for us as a nation, we can always lay our hands upon almost any number—certainly in Tibet there were dozens of men who have, not merely physical energy, nor merely animal courage, nor merely professional zeal, but, in addition to all these, that good heartedness and a capacity for getting on with all kinds of people, and tactfulness, which enables them to carry an expedition to countries which, but for this tactfulness, it would be impossible to penetrate at all. Among such men was Major Ryder, who on a previous occasion had travelled for two years in Western China, and had, in the service of the Government of India, surveyed in Burma and in many other places upon the Indian frontier. He had lived with me for many months in Tibet, and I had there seen and been able to test his great industry and his capacity for surveying, and his thorough zeal in whatever he undertook, whether it was the management of the mess, or, as he had to do at this time last year, organize the defences of a post as we had to at Gyangtse in the face of the enemy. An equally good man was Captain Rawling, who had, in the year previously, made an excellent expedition into Western Tibet, and had there by his tact been able to get himself out of some exceedingly nasty positions in which he found himself at a time when the Tibetans were not altogether friendly with us. Captain Wood and Lieut. Bailey were similar men, and it was due to their tactfulness that this expedition has been able to get through successfully and leave a good disposition behind them which will enable future travellers to fill in, I hope, a great deal that is still left to be done. It was due to their tactfulness that they were able to get this expedition through. I need not, however, say that sending this expedition caused all those who had originated it a great deal of anxiety, for we were close on to winter. As soon as negotiations were far enough advanced for me to be able to put the matter before the Tibetans I had done so; that was well on to September, and after that the approval of the Government of India had to be obtained, and the time was passing by till it was on the verge of winter when the expedition set out. This was one cause of anxiety. Another cause was that, just as the troops were being withdrawn from Tibet, it could hardly have been taken as the precise moment in which to launch an expedition 800 or 1000 miles into the unknown. It was, however, with immense relief that we heard of the safe arrival of this party in India. They had gone all the way from Lhasa either on foot or on ponies, they had surveyed the whole way under the difficulties so well illustrated in Major Ryder's lecture and in his slides, and they had come out successfully. This would have been a magnificent performance if it had been undertaken in the very best of weather, and at a time when we could count upon the absolute friendliness of the Tibetans; but that it was done at the very worst season of the year, and at a time when we could only hope for, but feel no assurance in, the friendly disposition of the inhabitants, I think shows that Major Ryder and his companions have done a work which has most thoroughly earned for him the highest honour of the Royal Geographical Society, which we are all very glad to hear has now been awarded him. I only hope that no less award will some day come to his leader, Captain Rawling. We must all congratulate Major Ryder and his companions most warmly on the success which has attended their efforts, and I am sure at the conclusion of this meeting we shall all join in thanking him for the very valuable paper he has read to us, and for the very striking photographs he has been able to put upon the screen.

Brigadier-General Sir Ronald MacDonald: I am afraid I have very little

to add to what Sir Frank Younghusband has already said. I can only say I do not think that Major Ryder in any way exaggerated, in fact he did not quite sufficiently draw attention to, the dangers that he had to face on this expedition. Sir Frank Younghusband has referred to the fact that the treaty had only lately been made, and although he had been very successful in leaving behind a feeling of respect, and I might almost say admiration, for our justice and methods, and had shown even the dawn of friendship with Tibet, yet it was a very big risk to take with a small body of officers with practically no escort, to trust themselves to the Tibetans on a journey of this length. I think I may almost say the dangers of the winter were in no wise exaggerated. During the present winter we had three times the snow on the pass that we experienced during the expedition, and there can be no doubt that had Major Ryder's party been a little later, he would have had to winter at Gartok instead of being here. I can speak myself on the work he did. At first the work was with the mission under Colonel Younghusband, and I have no knowledge of his work while he was at Kampa Dzong; but when the survey was transferred to the force I had the honour to command, I can testify to Major Ryder's zeal in his geographical work, and to the loyalty with which he carried out the necessary plans and subsidiary work which were essential from a military point of view. As regards his work at Gyangtse when the mission was beleaguered there, every one who has seen it has admitted that it was high-class field engineering, and there is no doubt that what he did in the way of defending the post added greatly to the comfort of those who had to undergo the unpleasant experience of sitting there waiting. While we were at Lhasa I am afraid I had somewhat to curtail some of Major Ryder's more ambitious schemes for extending his survey. But circumstances would not admit of that; but even so, I think that when all the results are compiled they will show that he has a very solid mass of work behind him which will add largely to our knowledge of a little-known country, and I cordially agree with Sir Frank Younghusband that Major Ryder is a credit to the corps of Royal Engineers, and thoroughly deserves all the honour which the Royal Geographical Society can show him.

Colonel GORE: As the person responsible for selecting Major Ryder to go on this mission, it has given me great gratification to hear of the splendid success which has attended the work of the survey. Major Ryder has given us a very modest account of what is, I think, the most wonderful bit of surveying that I can call to mind. Nobody but a surveyor who has taken part in that sort of work, and under those difficulties, can thoroughly realize what it means to carry on a continuous running triangulation in a mountainous country of that nature and under those climatic conditions. The day is always too short for the work to be done; the cold is such that the fingers get numbed and refuse to do their work, and one's moustache, if one incautiously bends low enough to touch the instrument, freezes on to the theodolite instantly. The problem of surveying in Tibet has always been a very difficult one for us in India. For mapping the greater and more important part of the country, we have had to depend on the work of native explorers sent in disguise, and this expedition has been particularly interesting to us, as it has given us the first opportunity we have had of testing the work done by these native explorers, and I am greatly pleased to hear of the accuracy of so much of their work. For many years no European or native of India proper has been allowed to enter those parts of the country, and so we have had to try and get natives from the borders of Tibet who can talk the Tibetan language, and were sufficiently Tibetan-like in appearance to be able to penetrate the country, and then teach them sufficient rough surveying for our purpose. The Tibetans, however, have always looked with great suspicion on such men, and even so regard

those border merchants who habitually cross into Tibet for trade purposes. Our trouble has always been to get border men who have sufficient intelligence to pick up enough surveying to do any good. I thought at one time of attaching these men to regular survey parties for a while, so that they might learn something of real topographical surveying in order that they might carry out their exploration work more intelligently, but I found that a course of survey work so smartened them up and made them so clean that there was no chance of mistaking them for Tibetans. We used to teach them to use a small hand-compass, which they could conceal in the palm of their hand, and they paced their distances, and the more experienced of them could take a latitude with a small sextant. Though, properly speaking, they could not map, they kept a field-book in which they recorded their observations, and a note-book in which they jotted down what sort of things occurred to them; but the sort of things that occurred to them would never occur to a man who wanted to make a map. It was all very well when you had an honest man, because he would do his best, and when he came to a difficulty he would own up and tell you of it, and then you made the best of it. But for the few that the Geographical Society knows of, there have been many who have been hopeless failures. I remember a man who went across the frontier who had had a large amount of training. He came back nine or ten months afterwards, and we were delighted to get hold of his field-books, and we started to see what we could make of them. The first thing that struck me was that they were a great deal too clean; they were nicely drawn out with headings and columns and so on, and it looked rather suspicious. He declared they were his originals, and so we went on and made the best of them. His work, however, did not fit in well, and it was out a good bit, and his latitudes would not fit in with the other work. And then I examined his field-book more closely, and I found he had got all his bearings down in the first column very nicely, but they had been put in as an old-fashioned seaman would put them in, in points. The second column was prismatic compass bearings, but a glance at them showed they were simply obtained by multiplying each of his double points by $22\frac{1}{2}°$, and that man swore he had taken them with the prismatic compass. His uncle was an old and honoured explorer, and what I am afraid was the case was that when he came back from his trip he went to his uncle's house, and between them they made up a new field-book. The work went the way of a good deal more: it found its way into the waste-paper basket—at least, it is lying in the office unused. Another man went round the great bend of the San-po, where that river turns south towards India, and penetrated southwards to the limit of the Tibetan country. He was then caught by the Tibetans and taken back through the lower part of Tibet bordering on Bhutan, and then set free. He brought back his work, but it proved to be useless and was not utilized, so that part of the course of the river is still a matter of some uncertainty. I think that Major Ryder and Captain Rawling have done a very wonderful survey, and they deserve every honour that can be conferred upon them.

Mr. Douglas Freshfield: I shall not detain the meeting this evening more than two minutes. There are certain remarks I might have made on the printed paper, but they are more the remarks of a geographer than those of a traveller, and they would refer to technical points which I think it would be unsuitable to bring forward in this meeting. I will only congratulate Major Ryder on having done one thing which will be very welcome to all mountaineers, and still more welcome to all schoolboys, as that is proved there is not to be a new highest mountain in the world—that the one which we have believed hitherto to be the highest still remains the highest. I would like to warn him of one thing. He spoke of it as "Everest." I hope the word "Mount" will not be habitually left out, and I will tell you the

reason why. A misguided friend of mine, a Fellow of the Royal Geographical Society, went to the backwoods of North America and discovered some new peaks among the Rocky mountains, one of which he called Mount Freshfield. He went back again next year, and found it easy to climb, and then he wrote "Freshfield has proved somewhat of an impostor." I hope this may never happen to Colonel Everest.

The PRESIDENT: Captain Rawling and Captain Wood are present, but I will not call upon them. We know what splendid work they both did, and we have seen their photographs, hard at work on the top of very breezy rocks. The Council, I am sure, will be as glad as I am to find that our opinion has been so fully corroborated by Sir Frank Younghusband, Sir Ronald MacDonald, and Colonel Gore, regarding the merits of Major Ryder and as it will be my duty this day week to express the Council's feelings on that subject, I need say no more now. But before closing the meeting, I cannot help saying how pleased I am to find that our Gold Medallist Nain Singh, and the other pundits sent by General Walker and Colonel Montgomerie forty years ago, were as accurate in their observations as they were courageous and loyal to their employers. I will now ask the meeting to pass a cordial vote of thanks to Major Ryder for the admirable paper he has read to us, and for the illustrations he has shown us.

ON THE NILE FLOOD AND ITS VARIATION.*

By Captain H. G. LYONS, F.R.G.S., F.G.S., Director-General Survey Department, Egypt.

Nile Gauge Records.—The data available for a discussion of the Nile floods are not inconsiderable, but the greater part of them are, unfortunately, of very unequal value on account of the irregularity of the readings at the Roda nilometer,† and of the falsification of its records, which is stated to have taken place in earlier times in order to increase the revenue. They may be summarized as follows:—

1. Readings of the Roda nilometer from 700 A.D. to 1903, but the readings for many years are missing.
2. Readings of the Nile gauge at the Delta Barrage from 1846 to 1878.
3. Readings of the Nile gauge at Aswan from 1869 to the present time.
4. Readings of the Nile gauge at Wadi Halfa from January, 1890, to the present time.
5. Readings of the Khartum Nile gauge from 1869 to 1883, and from 1900 to the present time.

The Aswan series of gauge-readings is the most complete, and will be used as the basis of this discussion. At the present time it may be considered that the Aswan dam, though its open sluices admit as free a

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* Continued from p. 272. Diagrams, p. 368. † At Cairo

passage of the flood-waters as possible, affects the old gauge, which is some 5 kilometres down-stream of it, and renders comparisons between readings at the present and those previous to 1901 unsatisfactory; but the gauge at Wadi Halfa has been in existence since 1890, and can therefore be used to confirm and complete the Aswan records.

The Aswan and Halfa gauges have a great advantage over those situated lower down the river, in that the whole flood of the river must pass in the river-channel at these points. Lower down the valley the flood-level of the river rises above the level of the country, and in years of high flood the embankments which should retain the waters in their bed may be breached; thus a lower gauge-reading will be recorded in the vicinity than if the whole flood has been confined to the river-channel. Also the normal flooding of the cultivated lands above Cairo takes a large amount of water from the river at the time of highest flood, so that the maximum range of the flood is not as high in the years when the Roda or Delta Barrage gauges have to be used as if only Aswan or Wadi Halfa readings could be employed. Since, however, the Aswan readings are available from 1869 only, it is necessary to employ those of the Roda gauge at Cairo from 1825 to 1870; before this there is a period of twenty-four years for which there are no records.

The Roda gauge, from its long series of observations, would be of inestimable value if its records were trustworthy, but, unfortunately, this has not always been the case.* For many years past, at least for two centuries, the sheikh of the nilometer has been in the habit of recording the height of the Nile by marks on the wall, and by the steps of the well in which the nilometer column is erected, instead of by the scale of cubits which is cut on the column. The cubits which are used by him are on the average 0·54 metre in length from the first to the sixteenth cubit inclusive, 0·27 metre from the seventeenth to the twenty-second cubit inclusive, and 0·54 metre for the twenty-third and all higher cubits.

The values given by Chélu† and by Willcocks‡ for the lengths of the cubits differ slightly. Cubits 14, 15, and 16 have been given by the latter as 0·48 metre to 0·49 metre only. However, the method of observation was certainly not one of great accuracy, and no considerable error will be introduced into the discussion of the yearly maxima if the values given by Willcocks are taken as being correct.

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* See also 'Description de l'Egypte,' vol. 18 (Paris: 1825); Manoug, 'Données utiles sur la crue du Nil' (Alexandrie: 1882); Ardagh, *Proc. R.G.S.*, 1889, p. 28; Manoug, *Proc. R.G.S.*, 1889, p. 245.

† 'Le Nil, le Soudan et l'Egypte,' pp. 84 and 87 (Paris: 1891); but the values on these two pages do not agree.

‡ 'Egyptian Irrigation,' App. V. p. 472. London: 1899.

Unfortunately, no original documents earlier than 1873 A.D. now exist in the Ministry of Public Works, Cairo, by which these readings may be verified. The series published by Ali Pasha Mubarik,* which is supposed to have been taken from original documents, is given for Mohammedan years, and when the beginning of a year, the 1st Moharrem, falls near the date when the Nile is highest, there is some doubt to which year the recorded maximum belongs, as no day of the month is mentioned. From 1846 to 1878, however, there is a series of readings at the Delta Barrage, 25 kilometres down-stream of the Roda gauge, which serves as a control. It will then be best to take the maximum readings as given by Tissot,† where the date of the maximum reading recorded is given for each year.‡ There is another series from 1737 A.D. to 1800, which appears to have been recorded under similar conditions, the range being much the same; and when the readings are converted to metres in the same way as those from 1825 to 1872, the mean maximum is 7·02 metres for the former as compared with 7·17 metres for the latter.

The Delta Barrage § records are less ambiguous. They extend from 1846 to 1872, and were kept daily for the whole year, and not for the flood only. No originals of these apparently exist in Egypt now, but the maxima are given in 'Statistique Générale de l'Egypt,'‖ and copies of all the observations were sent by Stone Pasha in 1880 to Colonel Donnelly, by whom they were given to the Science and Art Department, London,¶ but these cannot now be traced. On the whole, these two sets of readings agree fairly well (Table XII.), and the mean difference between them is 0·30 metre, which is not very far from the difference obtained by using the flood-slope of 1 : 10, 300, and a distance of 25 kilometres, *i.e.* 0·26 metre.**

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* 'El Khitat el Taufikia el Gedida li Misr el Kahira,' chap. xviii. Cairo: 1306 A.H.

† 'Statistique de l'Egypte.' Cairo: 1883.

‡ It should be mentioned that the original observations were made according to the Coptic (Julian) calendar, and Ali Pasha Mubarik has converted them into the corresponding Mohammedan years. Here, however, an error has crept in. No Nile maximum occurred in the year 1270 of the Hegira, one falling at the end of 1269 A.H., and the next at the beginning of 1271 A.H., though he has recorded that for 1271 A.H., as if it belonged to the year 1270 A.H., and so on. Thus all the Nile floods from 1854 to 1862 are given a year too early; but by recording the flood of 1862 to both 1278 A.H. and 1279 A.H., the years after this have been made correct.

§ A point 25 kilometres below the Roda Nile gauge, where the Rosetta and Damiette branches diverge, the real apex of the Delta.

‖ Cairo: 1879. Also see Fritz, in *Meteorologische Zeitschrift*, 1880, p. 303.

¶ *Nature*, vol. 25, p. 269, January 19, 1882.

** Willcocks, 'Egyptian Irrigation,' plate ii. London: 1900.

TABLE XII.

Year.	Maximum reading.		Difference.
	Roda gauge.	Barrage gauge.	
	metres.	metres.	metre.
1846	7·55	7·24	−0·31
1847	7·10	6·48	−0·62
1848	7·70	7·53	−0·17
1849	7·68	7·35	−0·33
1850	6·46	6·13	−0·33
1851	7·77	7·38	−0·39
1852	6·35	6·01	−0·34
1853	7·77	7·76	−0·01
1854	7·55	7·50	−0·05
1855	6·20	5·94	−0·26
1856	7·75	7·46	−0·29
1857	6·48	6·09	−0·39
1858	6·40	6·07	−0·33
1859	6·32	5·90	−0·42
1860	7·67	7·27	−0·40
1861	7·90	7·73	−0·17
1862	7·04	6·65	−0·39
1863	8·11	7·73	−0·38
1864	5·95	5·80	−0·15
1865	7·02	6·52	−0·50
1866	8·31	7·76	−0·55
1867	6·46	6·38	−0·08
1868	5·87	5·83	−0·04
1869	8·40	7·85	−0·55
1870	7·92	7·50	−0·42
1871	7·38	7·48	+0·10
1872	7·65	7·32	−0·33
		Roda Barrage=0·30	

The daily readings of this gauge for 1846–7–8–9 are given by Jomard and Malte-Brun,* and 5-day means for 1846–1861 have been published by d'Arnaud.†

In about seven or eight years the differences are irregular, due perhaps, in some cases, to breaching of banks, perhaps to incorrect records, but in three cases the years are those of exceptionally high floods, and thus the 20 or 30 centimetres will not affect the argument. Generally, then, it may be said that as far back as 1846 the data are sufficiently reliable. If, then, the Roda gauge records are so far reliable, it would seem that the others from 1827 to 1845 might also be accepted, though at this time there is no other gauge to confirm them. It happens, however, that from 1827 to 1839 the floods of 1829 and 1834 alone exceed the mean of the maximum readings 1827–1872, and therefore confirmatory evidence that twelve of these years were abnormally low is very desirable. That in 1829 the flood was an exceptionally high one is mentioned by Barker‡ in a letter dated September 1, 1829.

* *Bull. Soc. Géog. Paris*, April, 1864.

† 'Mémoires de l'Institut Egyptien,' t. 1, p. 115. Paris: 1861. Also *Zeitschr. f. Allg. Erdkunde*, Bd. 14.

‡ 'Syria and Egypt under the Last Five Sultans of Turkey,' vol. 11, p. 110. London: 1876.

Curzon * mentions that in 1833 the flood was feeble and late, so that on August 28 9 feet more were needed to ensure an average crop. The years 1836 and 1837 were very low, especially the latter, and this is recorded by Holroyd, † who says, "the rise of the Nile this year (1837) is less than it has for been five or six years past;" and also by Bowring.‡ Russegger also mentions that the Blue Nile had already fallen at Khartum 2 feet on August 20, 1837, though it rose again on August 30.§

Lefébvre says that of the five years 1839–1843, during which he was in Abyssinia, two had excessive rainfall, while three were deficient. ‖ These would correspond with the high floods of 1840, 1841, and 1842, and the low ones of 1839 and 1843, so the numbers of dry and wet seasons seem to be misplaced.

Thus we may accept the Roda gauge-readings as sufficiently accurate for investigating the question of the yearly variation of the Nile flood.

The Aswan gauge was established by Mahmud Pasha el Felaki in 1869, on the island of Elephantine, in the same covered stairway as the ancient Egyptian nilometer, but on the other wall face. For this daily readings are available from June 19, 1869, to the present date, except during an interval from November 13, 1869, to March 1, 1870, during which no readings were recorded; the scale is in piks and qirats; 1 pik = 24 qirats = 0·540 metre.

The gauge at Wadi Halfa was built in 1890, and daily readings exist from the beginning of January, 1890, to the present time.

At Berber a gauge was erected, and the reading was recorded daily during the flood for the years 1880–1–2–3.

Year.	From.	To.
1880	June 10	September 26
1881	,, 10	October 9
1882	,, 11	,, 9
1883	,, 11	,, 9

In 1900 a new gauge was erected here, but no connection between the old and the new series of readings could be established.

The old Khartum gauge was erected in 1864,¶ when Musa Pasha was governor of the Sudan, and the daily readings were taken from the first commencement of the rise till the flood was past. It is not known whether these began in 1865, but the only series of daily gauge-

* 'Visits to the Monasteries in the Levant,' p. 27. London: 1850.
† 'Egypt and Mohamed Ali Pasha in 1837,' p. 28. London: 1838.
‡ 'A Report on Egypt and Candia,' p. 14. London: 1840.
§ 'Reisen in Europa, Asien und Afrika,' vol. 4, p. 413. Stuttgart: 1844.
‖ 'Voyage en Abyssinie,' vol. 3, p. 10. Paris: 1840.
¶ *Pet. Mitt.*, 1864, p. 308.

readings at Khartum which now exists is from 1869 to 1883; these were taken daily from about the middle of May till the end of October, or the early part of November.

	1869.	1870.	1871.	1872.	1873.	1874.	1875.	1876.
From ...	May 19	May 19	May 17	May 8	May 11	May 8	May 8	May 8
To ...	Nov. 9	Oct. 29	Sept. 28	Oct. 2	Sept. 24	Nov. 9	Nov. 9	Nov. 9

	1877.	1878.	1879.	1880.	1881.	1882.	1883.	
From ...	May 10	May 10	May 10	May 10	May 8	May 19	May 19	
To ...	Oct. 15	Oct. 29	Oct. 29	Oct. 29	Oct. 29	Oct. 29	Oct. 29	

These were interrupted by the Mahdist revolt, and were not resumed until 1900, from which date they have been recorded daily throughout the year up to the present time. It has not been possible to determine the site of the old gauge of 1869–83 with sufficient accuracy to refer the readings of the present gauge to it.

Therefore, by utilizing the Roda gauge-readings from 1825 to 1872, and the Aswan gauge readings from 1871 to 1902, and the Wadi Halfa gauge for any subsequent years, we have a series of maximum readings of the Nile flood for 80 years, which are very fairly accurate, since for almost every year there was another gauge which was simultaneously recording the river-levels:—

Period.	Gauge.	Verified by
1825–1845	Roda	Barker, Holroyd, Bowring, Curzon, etc.
1845–1872	,,	Delta Barrage gauge.
1871–1902	Aswan	Roda, Barrage, and other gauges.
1891–1904	Wadi Halfa	Aswan and many other gauges.

These maxima may be graphically represented by plotting them as differences from the mean value of the series, as has been done in Fig. V.

Gauge-readings furnish only the level of the water surface from day to day, and not the volume of the water flowing past, which is really required. At Aswan a number of discharges were measured and a discharge-table computed, by which the volume flowing past that point at any given reading of the gauge could be determined.* At Khartum on the Blue Nile, and at Dueim on the White Nile, and on the Atbara discharges have been measured in 1902 and 1903, from which the volume of the floods of these years can be calculated with fair accuracy; these have been already discussed.

* 'Perennial Irrigation,' App. III. Table I. Cairo: 1894.

The volume discharged by the Nile in flood represents the surface run-off of the rainfall of the catchment basin, while that of the rest of the year is due to what has percolated into the ground and fed the springs; it is, therefore, the volume discharged by the river in flood which should be used in comparing the floods of different years, and the maximum gauge-readings of different years do not accurately represent this. As, however, it will be necessary to discuss as long a series of floods as possible to see if they show any trace of periodicity, whether a group of years of low flood is followed by a group of years of high flood with any regularity, it will be necessary before 1869 to employ the records of the Roda nilometer or those taken at the Delta Barrage.

When discharge observations are not available, the floods of various years can be represented in the following manner, which is more accurate than the maximum gauge-readings if daily readings are available: Five-day means* of the readings are taken for each year, and the average reading of each five-day period for all the years is taken; then the difference between a five-day mean for year and for the corresponding period of the series of years will show when the flood is above or below the average for each such five-day period. The sum of these differences furnishes a good means of comparing the different floods, though it is inferior to actual measurements of the discharge, since by using the sum of these differences it is assumed that the discharge increases in direct proportion to the rise of the gauge, whereas the discharge increases more rapidly, and a 0·10 metre rise at flood stage corresponds to a larger volume of water passing than a rise of the same amount at a lower stage of the river, while a gauge reading on a rising stage represents a larger discharge than the same reading on a falling stage.

As, however, it is necessary to employ the maximum readings as a basis of comparison between the floods of different years before 1869, it will be well to examine the relation between the floods of the years 1871 to 1902 as shown by—

(*a*) The volume of water discharged between July 1 and October 31.

(*b*) The sum of the differences between the five-day means and the average five-day mean between July 1 and October 31.

(*c*) The maximum gauge-readings.

If three curves are plotted representing the relative magnitudes of thirty-four Nile floods at Aswan according to the three methods above described, it is interesting to notice how closely they follow each other. Taking the curve of the "volumes discharged" as the most accurate, the curve of "differences from mean gauge" follows it closely, being sometimes slightly above it, at other times slightly below it. The agreement of the curve of "maximum gauge-readings" is less satisfactory, as would be expected; though it usually agrees fairly well, on

* That is, 1–5, 6–10, 11–15, 16–20, 21–25, 26 to the end of the month.

one or two occasions it differs markedly; for instance, in 1881, 1882, and in 1896. However, it may be claimed that, for the purpose of the present investigation, the curves of "differences from mean gauge" may fairly be used as a close approximation to the volume discharged for places such as Wadi Halfa and Khartum, 1869–1880, where daily readings for a series of years are available, while the curve of maximum gauge-readings will reproduce generally the shape of "volume discharged" curve, though occasionally diverging from it to some extent. It is the "maximum reading" curve alone which is available for Roda and the Delta Barrage * observations.

We therefore possess fairly reliable records of the maximum readings of the Nile floods for eighty years past. As far as 1846 these records can be controlled by the records of other gauges, and before that date the contemporary evidence of travellers and residents enables us to verify several of the more important years. These data should show some signs of an alternating series of high and low floods, that is of a periodicity in the floods, if such does exist. Brückner † has shown a periodicity in rainfall of thirty-five years from maximum to maximum, which he traces generally throughout the continental areas of the world, and which might be expected to appear here also.

In examining the Nile floods records for traces of periodicity, it must be remembered that it is the variation of the Abyssinian rainfall which is really being discussed, and the flood is used as being a convenient expression for the run-off, which is assumed to bear a fairly constant proportion each year to the rainfall. No data exists by which this assumption may be verified, but it is probably a reasonable one.

Flood Discharge, 1869–1902.—In Table XIII. is given the volume discharged in each year from 1869 to 1902 from July 1 to October 31, which has been computed from the discharge table given by Sir W. Willcocks.‡ The ratio between floods of different magnitude bears out what has been deduced from two years' discharges at Khartum (see pp. 264, 265), namely, that an abnormally low Nile is about two-thirds of the volume of a normal flood, while a maximum flood is nearly the double of an abnormally low flood. These proportions should naturally be reproduced in the Abyssinian rainfall of these years, but observations there are as yet too few to show this clearly.

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* Except for the years 1846–61, for which five-day means have been published by d'Arnaud.

† 'Klimaschwankungen.' Vienna: 1890.

‡ 'Perennial Irrigation,' App. III., Table 1. Cairo: 1894.

TABLE XIII.

VOLUME OF FLOOD AT ASWAN, JULY 1 TO OCTOBER 31, IN MILLIONS OF CUBIC METRES.

Year.	Ratio to mean flood.	Volume.	Variation from mean.	Mean of five years.	Variation from five-year mean.
1869	1·18	77,133·6	+11,965·4	—	—
1870	1·23	80,183·5	+14,995·3	—	—
1871	1·05	68,371·8	+ 3,183·6	70,551·7	+ 5,249·1
1872	1·11	72,065·4	+ 6,877·2	71,669·5	+ 6,366·9
1873	0·84	55,004·4	−10,183·8	69,992·2	+ 4,689·6
1874	1·26	82,622·6	+17,434·4	70,493·5	+ 5,190·9
1875	1·10	71,896·9	+ 6,708·7	65,197·3	− 105·3
1876	1·09	70,878·2	+ 5,690·0	70,312·8	+ 5,010·2
1877	0·70	45,584·2	−19,604·0	68,625·9	+ 3,323·3
1878	1·24	80,582·3	+15,394·1	67,089·7	+ 1,787·1
1879	1·14	74,187·8	+ 8,999·6	65,047·9	− 254·7
1880	0·98	64,215·9	− 972·3	66,857·8	+ 1,555·2
1881	0·93	60,669·2	− 4,519·0	64,302·7	− 999·9
1882	0·84	54,633·7	−10,554·5	60,350·5	− 4,952·1
1883	1·04	67,806·7	+ 2,618·5	60,439·0	− 4,863·6
1884	0·83	54,427·2	−10,761·0	60,171·9	− 5,130·7
1885	0·99	64,658·3	− 529·9	64,769·1	− 533·5
1886	0·91	59,333·5	− 5,854·7	60,568·0	− 4,734·6
1887	1·19	77,619·6	+12,431·4	62,659·8	− 2,642·8
1888	0·72	46,801·6	−18,386·6	64,363·7	− 938·9
1889	1·00	64,886·0	− 302·2	65,606·0	+ 303·4
1890	1·12	73,177·8	+ 7,989·6	65,738·0	+ 435·4
1891	1·01	65,544·8	+ 356·6	69,274·8	+ 3,972·2
1892	1·20	78,279·7	+13,091·5	72,190·1	+ 6,887·5
1893	0·99	64,485·9	− 702·3	72,556·6	+ 7,254·0
1894	1·22	79,462·5	+14,274·3	73,338·6	+ 8,036·0
1895	1·15	75,009·9	+ 9,821·7	69,259·8	+ 3,957·2
1896	1·06	69,455·2	+ 4,267·0	70,257·4	+ 4,954·8
1897	0·89	57,885·4	− 7,302·8	62,565·1	− 2,737·5
1898	1·07	69,473·8	+ 4,285·6	59,180·8	− 6,121·8
1899	0·63	41,001·1	−24,187·1	56,595·1	− 8,707·5
1900	0·89	58,088·4	− 7,099·8	53,306·5	−11,996·1
1901	0·87	56,526·8	− 8,661·4	51,049·9	−14,252·7
1902	0·63	41,442·6	−23,745·6	—	—
1903	0·89	58,190·4	− 6,997·8	—	—
	Mean ...	65,188·2	Mean ...	65,302·6	

It will be noticed that the mean volume discharged is 65,188 million cubic metres, which is not much greater than that obtained from the Khartum observations for 1903, a year somewhat below the normal, although the Aswan volume includes the discharge of the Atbara, and also that which the White Nile was contributing, a quantity which in July and October is not inconsiderable, though small in August and September (see Table VI.). These Aswan values would appear, therefore, to be rather below the truth. In the memoir where the discharge table is published, no details are given of the observations from which the table was computed. The greater discharge when the river is rising than when it is falling, for the same gauge-reading, is mentioned, but it is not stated how this was dealt with in preparing the table. However, though the totals may be rather low, their ratios to

one another should not be appreciably altered, and for the present investigation it is these ratios which are required.

In 1904, the volume of the flood calculated in the same way was 49,020·8 millions of cubic metres, being 0·75 of a mean flood.

TABLE XIV.

MAXIMUM READINGS, ASWAN GAUGE.

A.D.	Metres.	Difference from mean.	Five-year mean.	Difference from mean.
1871	8·25	+0·14	—	—
1872	8·27	+0·16	—	—
1873	7·66	−0·45	8·30	+0·15
1874	8·97	+0·86	8·39	+0·24
1875	8·36	+0·25	8·01	−0·14
1876	8·68	+0·57	8·32	+0·17
1877	6·40	−1·71	8·25	+0·10
1878	9·21	+1·10	8·14	−0·01
1879	8·59	+0·48	8·03	−0·12
1880	7·82	−0·29	8·35	+0·20
1881	8·14	+0·03	8·15	0·00
1882	8·00	−0·11	7·97	−0·18
1883	8·18	+0·07	8·02	−0·13
1884	7·73	−0·38	8·00	−0·15
1885	8·05	−0·06	8·16	+0·01
1886	8·04	−0·07	7·94	−0·21
1887	8·81	+0·70	8·07	−0·08
1888	7·08	−1·08	8·20	+0·05
1889	8·36	+0·25	8·16	+0·01
1890	8·72	+0·61	8·18	+0·03
1891	7·84	−0·27	8·31	+0·16
1892	8·88	+0·77	8·36	+0·21
1893	7·75	−0·36	8·35	+0·20
1894	8·61	+0·50	8·51	+0·36
1895	8·68	+0·57	8·30	+0·15
1896	8·63	+0·52	8·47	+0·32
1897	7·80	−0·31	8·08	−0·07
1898	8·63	+0·52	7·93	−0·22
1899	6·67	−1·44	7·77	−0·38
1900	7·91	−0·20	7·55	−0·60
1901	7·91	−0·20	—	—
1902	7·82	−0·29	—	—

Tables XVI. and XVII. contain the maximum readings of the Roda gauge from 1736–1800, and from 1825 to 1872, together with the differences from the mean maximum and also the five-year means. Table XVIII. contains the same for the Barrage.

TABLE XV.

MAXIMUM READINGS OF RODA GAUGE.

A.D.		Metres. +12·50.	Difference from mean.	Five-year mean. Metres. +12·50.	Five-year difference from mean.
	Pik. Qirat.				
1825	19 4	5·96	−1·21	—	—
1826	22 18	7·13	−0·04	—	—
1827	22 8	6·91	−0·26	6·90	−0·27
1828	21 14	6·62	−0·55	7·01	−0·16
1829	24 2	7·87	+0·70	6·98	−0·19
1830	21 8	6·54	−0·63	6·95	−0·22
1831	22 11	6·98	−0·19	6·80	−0·37
1832	21 23	6·73	−0·44	6·73	−0·44
1833	18 23	5·90	−1·27	6·64	−0·53
1834	23 10	7·50	+0·33	6·52	−0·65
1835	19 15	6·08	−1·09	6·36	−0·81
1836	20 17	6·37	−0·80	6·50	−0·67
1837	19 4	5·96	−1·21	6·39	−0·78
1838	21 12	6·59	−0·58	6·71	−0·46
1839	22 9	6·93	−0·24	7·00	−0·17
1840	23 18	7·68	+0·51	7·32	+0·15
1841	24 0	7·83	+0·66	7·38	+0·21
1842	23 14	7·59	+0·42	7·35	+0·18
1843	22 6	6·87	−0·30	7·09	−0·08
1844	22 3	6·80	−0·37	7·08	−0·09
1845	20 15	6·35	−0·62	7·03	−0·14
1846	23 23	7·80	+0·63	7·24	+0·07
1847	23 2	7·31	+0·14	7·47	+0·30
October 2, 1848	24 6	7·96	+0·79	7·54	+0·37
,, 7, 1849	24 5	7·93	+0·76	7·58	+0·41
September 19, 1850	21 20	6·69	−0·48	7·43	+0·26
October 3, 1851	24 9	8·02	+0·85	7·44	+0·27
August 31, 1852	21 8	6·54	−0·63	7·41	+0·24
October 1, 1853	24 9	8·02	+0·85	7·35	+0·18
September 29, 1854	23 23	7·80	+0·63	7·35	+0·18
1855	20 18	6·39	−0·78	7·38	+0·21
October 2, 1856	24 8	8·00	+0·83	7·10	−0·07
September 13, 1857	21 22	6·71	−0·46	6·85	−0·32
,, 6, 1858	21 14	6·62	−0·55	7·16	−0·01
October 27, 1859	21 7	6·53	−0·64	7·19	+0·02
,, 17, 1860	24 5	7·93	+0·76	7·30	+0·13
September 27, 1861	24 16	8·17	+1·00	7·65	+0·48
October 22, 1862	23 0	7·26	+0·09	7·58	+0·41
September 20, 1863	25 1	8·37	+1·20	7·44	+0·27
,, 20, 1864	19 21	6·15	−1·02	7·52	+0·35
October 18, 1865	22 23	7·24	+0·07	7·41	+0·24
September 27, 1866	25 11	8·59	+1·42	6·95	−0·22
,, 11, 1867	21 22	6·71	−0·46	7·45	+0·28
August 27, 1868	19 13	6·05	−1·12	7·65	+0·48
October 11, 1869	25 15	8·68	+1·51	7·45	+0·28
,, 14, 1870	24 17	8·20	+1·03	7·69	+0·52
September 27, 1871	23 16	7·63	+0·46	—	—
October 20, 1872	24 3	7·89	+0·72	—	—
	Mean ...	7·17		Mean ... 7·17	

Readings are taken from 'Statistique de l'Egypte,' 1883; see also Fritz, *Met. Zeit.*, vol. 8, p. 363.

TABLE XVI.

RODA GAUGE.

A.D.	Pik.	Qirat.	Metres. +12·50.	Difference from mean.	Five-year mean. Metres. +12·50.	Difference from mean.
1737	20	18	6·39	−0·63	—	—
1738	24	12	8·09	+1·07	—	—
1739	23	12	7·54	+0·52	7·49	+0·47
1740	24	6	7·96	+0·94	7·72	+0·70
1741	23	8	7·46	+0·44	7·50	+0·48
1742	23	12	7·54	+0·52	7·44	+0·42
1743	22	12	7·00	−0·02	7·42	+0·40
1744	23	0	7·26	+0·24	7·43	+0·41
1745	24	0	7·83	+0·81	7·54	+0·52
1746	23	19	7·71	+0·69	7·51	+0·49
1747	24	3	7·89	+0·87	7·38	+0·36
1748	22	6	6·87	−0·15	7·29	+0·27
1749	21	12	6·59	−0·43	7·31	+0·29
1750	63	5	7·39	+0·37	7·24	+0·22
1751	24	0	7·83	+0·81	7·45	+0·43
1752	23	12	7·54	+0·52	7·43	+0·41
1753	24	3	7·89	+0·87	7·44	+0·42
1754	21	6	6·52	−0·50	7·44	+0·42
1755	23	6	7·41	+0·39	7·55	+0·53
1756	24	0	7·83	+0·81	7·59	+0·57
1757	24	12	8·09	+1·07	7·62	+0·60
1758	24	12	8·09	+1·07	7·56	+0·54
1759	21	19	6·68	−0·34	7·50	+0·48
1760	22	17	7·11	+0·09	7·16	+0·14
1761	23	12	7·54	+0·52	7·02	0·00
1762	20	17	6·37	−0·65	7·25	+0·23
1763	23	6	7·41	+0·39	7·31	+0·29
1764	24	0	7·83	+0·81	7·20	+0·18
1765	23	5	7·39	+0·37	7·19	+0·17
1766	22	12	7·00	−0·02	6·97	−0·05
1767	20	12	6·32	−0·70	7·05	+0·03
1768	23	5	7·39	+0·37	7·00	−0·02
1769	23	12	7·54	+0·52	7·03	+0·01
1770	21	12	6·59	−0·43	6·70	−0·32
1771	23	6	7·41	+0·39	6·89	−0·13
1772	19	16	6·09	−0·93	6·71	−0·31
1773	21	6	6·52	−0·50	6·89	−0·13
1774	22	6	6·87	−0·15	7·07	+0·05
1775	23	12	7·54	+0·52	6·89	−0·13
1776	21	6	6·52	−0·50	7·07	+0·05
1777	22	12	7·00	−0·02	7·26	+0·24
1778	23	6	7·41	+0·39	7·26	+0·24
1779	24	0	7·83	+0·81	7·33	+0·31
1780	23	12	7·54	+0·52	7·07	+0·05
1781	22	6	6·87	−0·15	6·72	−0·30
1782	18	6	5·70	−1·32	6·31	−0·71
1783	18	2	5·66	−1·36	6·04	−0·98
1784	18	12	5·77	−1·25	6·02	−1·00
1785	20	0	6·18	−0·84	6·30	−0·72
1786	22	2	6·78	−0·24	6·57	−0·45
1787	22	17	7·11	+0·09	6·77	−0·25
1788	22	12	7·00	−0·02	6·87	−0·15
1789	22	2	6·78	−0·24	6·80	−0·22
1790	21	18	6·66	−0·36	6·59	−0·43
1791	21	0	6·46	−0·56	6·43	−0·59
1792	19	14	6·07	−0·95	6·28	−0·74
1793	20	0	6·18	−0·84	6·23	−0·79
1794	19	12	6·04	−0·98	6·21	−0·81
1795	20	21	6·42	−0·60	6·26	−0·76
1796	20	12	6·32	−0·70	6·48	−0·54
1797	20	16	6·36	−0·66	6·56	−0·46
1798	22	23	7·24	+0·22	6·73	−0·29
1799	20	23	6·44	−0·58	—	—
1800	23	2	7·31	+0·29	—	—
	Mean ...		7·02		7·02	

TABLE XVII.

NILE GAUGE-READINGS AT BARRAGE (Fritz in *Met. Zeit.* vol. **15**, 1880, p. 303).

A.D.	Metres.	Difference from mean.	Five-year mean.	Difference from mean.
1846	7·24	+0·33	—	—
1847	6·48	−0·43	—	—
1848	7·53	+0·62	6·95	+0·02
1849	7·35	+0·44	6·97	+0·04
1850	6·13	−0·78	6·90	−0·03
1851	7·38	+0·47	6·92	−0·01
1852	6·01	−0·90	6·96	+0·03
1853	7·76	+0·85	6·92	−0·01
1854	7·50	+0·59	6·93	0·00
1855	5·94	−0·97	6·95	+0·02
1856	7·46	+0·55	6·61	−0·32
1857	6·09	−0·82	6·29	−0·64
1858	6·07	−0·84	6·59	−0·34
1859	5·90	−1·01	6·61	−0·32
1860	7·27	+0·36	6·72	−0·21
1861	7·73	+0·82	7·06	+0·13
1862	6·65	−0·26	7·04	+0·11
1863	7·73	+0·82	6·89	−0·04
1864	5·80	−1·11	6·89	−0·04
1865	6·52	−0·39	6·84	−0·09
1866	7·76	+0·85	6·46	−0·47
1867	6·38	−0·53	6·87	−0·06
1868	5·83	−1·08	7·06	+0·13
1869	7·85	+0·94	7·01	+0·08
1870	7·50	+0·59	7·19	+0·26
1871	7·48	+0·57	7·30	+0·36
1872	7·32	+0·41	7·35	+0·42
1873	6·45	−0·46	7·28	+0·35
1874	7·98	+1·07	7·28	+0·35
1875	7·15	+0·24	6·85	+0·08
1876	7·50	+0·59	7·20	+0·27
1877	5·18	−1·73	—	—
1878	8·20	+1·29	—	—
Mean ...	6·91		6·93	

In seeking for evidence of periodicity in a long series of observations, it is often helpful to eliminate as far as possible small accidental variations which may otherwise hide the periodical variations. This is conveniently done by taking successively the means of groups of five years, and then comparing these mean values. For studying the effect of varying meteorological conditions the yearly values are necessary, and in the tables both the yearly values and the five-year means are given; the former being more useful in studying the effect of the meteorological conditions and the possibility of prediction, while the latter concerns the question of periodicity.

On Fig. V. the Nile floods for the 78 years 1825–1902 are shown, as well as an earlier series of 64 years from 1737 to 1800 on Fig. VI.; up to 1872 the variation of the maximum reading of the Roda gauge from the mean* is plotted on the scale of 1 : 20, but from 1869 to 1903†

* Column 4 of Table XV.

† Column 4 of Table XIII.

the variation of the volume discharged in each year's flood from the mean value for the 32 years 1871–1902 is plotted on the scale of 1 centimetre to 200 millions of cubic metres. Over this record of the yearly flood is plotted the curve of the five-year means,* the mean value for each five-year group being plotted under the middle year of the group.†

In the first place, the more reliable series 1825–1902 will be examined, for any sign of a regular alternation of groups of high and low floods will have a greater value here than in the older series, being obtained from more reliable data. The five-year mean curve shows a certain alteration; low periods occur as follows:—

	Duration.	Intervening period.
1829–1848	19 years	8 years.
1856–1860	4 „	21 „
1881–1888	7 „	9 „
1897–1902	5 „	

But these intervening high-flood periods are broken by groups of years which reduce the curve to the normal line, as in 1843–46, 1855–56, and 1867. To take the Aswan observations 1869–1903 alone, an apparent periodicity of about seventeen years from maximum to maximum occurs, but in the preceding years no trace of such period is to be found.

Fritz,‡ when discussing the Roda series 1825–1872 and the Delta Barrage series from 1846–1878, believed that a relation could be made out between the high and low Nile floods and the maxima and minima of the sunspot curve, and Waite § has recently maintained the same. On Figs. V. and VI. the sunspot curve has been plotted from the numbers given by Wolfer,‖ but it does not appear to bear any definite relation to either the five-year curve or the yearly flood curve; the maximum of 1837 coincided with a group of particularly low floods, that of 1846 with a high-flood period. In 1860 the sunspot maximum occurred just before the high floods of 1860 and 1861, and after the low years of 1857–59; the low sunspot maximum of 1883 occurred at the time of a group of low floods, and the improved Nile supply came in 1887, 1889, and 1890, when the sunspots were at minimum. Whatever connection may finally be worked out between sunspots and meteorological phenomena, it seems clear that the Abyssinian rainfall is due to the combined effect of causes which usually prevent any coincidence between high and low floods and the maxima and minima of the sunspots which may exist, from being recognized, and to predict improved

* Tables XIII. and XIV.

† The mean of 1871–1875 is plotted under 1873, and that for 1872–1876 under 1874, and so on.

‡ *Met. Zeit.*, **13**, p. 363; and **15**, p. 303.

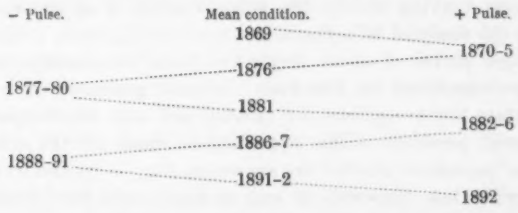
§ *Scot. Geog. Mag.*, 1904, p. 487.

‖ Waite, *loc. cit.*

floods on the basis of an approaching sunspot maximum * seems to go further than the evidence warrants.

In 1900, Sir N. Lockyer and Dr. W. Lockyer † discussed periodical pulses of rainfall, which they distinguished as + and − pulses connected with + and − heat pulses of the solar weather cycle.

As a result of an examination of the spectra of sunspots and of the rainfall of India and Mauritius, they concluded that India has two pulses of rainfall, the one near the maximum and the other near the minimum of the sunspot period, and that the dates of the beginning of these two pulses are related to sudden changes in widened lines of the spectra. The famines of India for the last half-century were found to occur in the intervals between these pulses, and the lowest Nile floods between 1849 and 1878 are said to have occurred between the same intervals. These pulses are given as follows:—



According to this view, then, low Nile floods should predominate about 1869, 1876, 1881, 1887, and 1892, while high floods should follow the years of the + and − pulses. They deal briefly with some of the Nile floods in this paper, pointing out that "the highest Niles follow the years of the + and − pulses."

1871	flood, 1 year after the + pulse of 1870.	
1876	„ 2 „	subsidiary pulse of 1874.
1879	„ 2 „	„ „ 1877.
1883–4	„ 1 and 2 years after the + pulse of 1882.	
1893–4	„ 1 „ 2 „	„ + „ 1892.

It does not seem, though, that such a direct and simple relation can be made out for the Abyssinian rainfall; the 1871 flood was less than those of 1869, 1870, or 1872, while 1874, and not 1876, was the big flood to compare with the pulse of 1874, and 1878 was a year of heavier rainfall than 1879, and particularly a very late rainfall, extending far into the autumn; 1883 and 1884 were moderate and rather low years respectively. These discrepancies are mentioned to show that the dates of the + and − pulses by themselves do not consistently precede

* *Met. Zeit.*, 1902, p. 193.
† *Proc. Royal Society*, vol. 67, p. 409.

specially high floods, and therefore this periodicity of five or six years is not traceable in the yearly or five-year Nile curves.

The low Nile floods quoted are those of 1858–9, 1868, 1873, 1877, but it should be noticed (see Fig. V.) that the floods of 1858–9 were not especially low; 1857 was almost as low as 1858, and 1855 was lower than either; 1868 was a very low year, but 1864 was almost as low; 1873 was a low flood, and 1877 a very low flood. Turning to the other "mean condition" years which should coincide with low floods, 1881 was a normal flood, 1887 was a good flood, though 1888 was a bad one, and 1892 was particularly good, 1888 and 1899 being the nearest bad years to this date.

It would seem, therefore, that Egypt and Abyssinia form an area in which the meteorological conditions are not regularly consonant with those of India discussed by Sir N. Lockyer; at times agreeing and at other times varying widely, the solar weather is as yet an uncertain guide in the study of Nile floods.

A longer period of about thirty-five years from maximum to maximum has been found by Brückner * to exist generally over the globe, with certain few exceptions, for rainfall and also for temperature and atmospheric pressure. The approximate dates of the maxima and minima of periods of rainfall are shown on Fig. V. by the words "Wet" and "Dry," † but they will be seen to stand in no fixed relation to the five-year mean curves of the Nile floods. If, however, we take the different rises and falls of the flood curve, we see that in departing from Brückner's regular curve it approaches to some extent the curve which he gives for the areas which he has classed as "temporary exceptions (*temporäre Ausnahme*)" ‡ (see Fig. IV.); these areas show a low period in the lustrum 1855–60, a well-defined high one in 1861–65, and again a brief though sharply marked low period in 1865–70, as well as a steady fall from 1875 to 1887. The areas described as "temporary exceptions" are naturally not very numerous compared with those following the regular alternation, and do not among themselves show a very close agreement, but the occurrence of an 1860–65 maximum of the Nile floods during a dry period, and steady increase in the lustra 1875–80 and 1880–85 in a normally wet period, show that the normal Brückner cycle cannot apply to the Abyssinian rainfall, and it is probable that any anticipations of improvement or diminution of coming floods based upon their position in this normal cycle will not be realized. In Fig. IV. are shown the curves for the regular and temporary exceptional areas of Brückner as well as the curve for the Nile floods; in each case the curve is plotted from the mean value of

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* 'Klimaschwankungen.' Vienna: 1890.

† Cf. *Ibid.*, p. 192; and *Pet. Mitt.*, 1902, pp. 173–176.

‡ 'Klimaschwankungen,' p. 171.

each lustrum. It can be seen that the Nile flood varied according to the normal type from 1830 until 1860, but after that departed markedly from it, especially about 1875 to 1885.

Turning now to the yearly curve for the seventy-eight years from 1821 to 1902 in Fig. V., the most marked feature is the way in which the flood varies, passing from a value above the normal to one below it in almost successive years. It is this irregularity, this rapid oscillation of the curve, which makes of small practical value any argument based on a periodicity shown by the five-year curve; for in the most regular group of low floods, a high flood may intrude itself, as 1829 and 1834, also 1887; while 1873 and 1877 were very low floods among a group of floods all much above the average. If this series of floods be examined, we shall see that from 1825 to 1903 the succession is as follows:—

In seventeen cases a flood *above* the average is followed by one *below* the average.

In eighteen cases a flood *above* the average is followed by one *above* the average.

In twenty-one cases a flood *below* the average is followed by one *below* the average.

In sixteen cases a flood *below* the average is followed by one *above* the average.

Even in periods when high or low Niles greatly predominate, such as 1825–1839 or 1860–1880, floods of the opposite character frequently occur, *e.g.* the high flood of 1829 in the first period of low floods, and the low floods of 1864, 1869, and 1877 in the high-flood period of 1860–1880.

In these seventy-eight years—

2	successive	years	above	the average	occur three times.
3	,,	,,	,,	,,	,,
4	,,	,,	,,	,,	,,
2	,,	below	,,	,,	once.
3	,,	,,	,,	,,	three times.
4	,,	,,	,,	,,	twice.
5	,,	,,	,,	,,	,,

of which the last two groups belong to the low-flood periods of 1825–1839 and 1899–1903.

Since the Nile flood is the direct result of the June—September rainfall on the Abyssinian tableland, the rains and the meteorological conditions which determine them must be subject to a similar oscillation to that which is so markedly shown in the flood diagrams. Essentially the succession of Nile floods for the last eighty years is an oscillation between floods above the average and floods below the average, and the same thing is seen in the series from 1737 to 1800 (Fig. VI.), though the range of the oscillation is not so large if the observations can be relied on.

The long series of years following 1738 in which the Nile flood was almost invariably good is corroborated by Bruce, who writes, "The Nile for these thirty years has but once so failed as to occasion dearth, but never in that period so as to produce famine in Egypt."* This refers apparently to the thirty years previous to 1773,† the low Nile being perhaps that of 1772. He further speaks of three of these floods having been exceptionally abundant, which would apply to those of 1757, 1758, and perhaps 1753. The exceptionally low floods of 1783 and 1784 are mentioned by Volney,‡ who speaks of them as causing a serious famine.

For comparison with this earlier series of years, rainfall data do not exist as for the nineteenth century; still, it can be said with certainty that the curve is not one which shows any more similarity to the alternating dry and wet groups of years having a period of about thirty-five years, than has been found in the later series.

We may conclude, then, with reference to the variation of the Nile flood from year to year, that no trace appears of any such definite periodicity as might be of assistance in estimating the probable duration of any succession of high or low Nile floods.

In the sixty-four years (1736–1800) of the eighteenth century, the oscillation between excessive and deficient floods is on the whole much the same as for the nineteenth century.

In thirteen cases a flood *above* the average is followed by one *below* the average.

In twenty cases a flood *above* the average is followed by one *above* the average.

In eighteen cases a flood *below* the average is followed by one *below* the average.

In twelve cases a flood *below* the average is followed by one *above* the average.

2	successive	floods	above	the	average occur twice.
3	,,	,,	,,	,,	,,
4	,,	,,	,,	,,	three times.
5	,,	,,	,,	,,	once.
2	,,	below	,,	,,	three times.
3	,,	,,	,,	,,	once.
6	,,	,,	,,	,,	,,
10	,,	,,	,,	,,	,,

The long period from 1781 to 1799, when apparently all floods except two were below the average, prevents any average length of the oscillation between floods in excess or defect being estimated satisfactorily.

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* 'Travels to discover the Source of the Nile,' 2nd edit., vol. 5, p. 375. London: 1805.

† *Ibid.*, p. 412, note.

‡ 'Voyage en Egypte et en Syrie,' 5th edit., vol. 1, p. 157. Paris: 1822.

Essentially, then, the Abyssinian rainfall, which we have represented by the Nile flood, fluctuates at short intervals, and does not increase more or less regularly for a period of years, and then decrease in a similar way. These fluctuations are short, and if the number of years between the different crests of the curve is taken (whether such crests rise above the average or not), the length of time between such crests is—

2	years	in twelve cases	in the	nineteenth century.
3	,,	six	,,	,, ,,
4	,,	three	,,	,, ,,
5	,,	four	,,	,, ,,
2	,,	five	,,	eighteenth ,,
3	,,	two	,,	,, ,,
4	,,	four	,,	,, ,,
5	,,	two	,,	,, ,,
8	,,	one case	in the	,, ,,
11	,,	,,	,,	,, ,,

We have, therefore, to deal with a comparatively short-period variation in the meteorological conditions, but this subject requires further investigation.

It is often said that the Indian monsoon rainfall and the Nile floods agree in showing excess or deficiency, but this is in reality far from being the case, and discordance is fairly frequent.

Sir W. Willcocks, in a paper at the Meteorological Congress at Chicago, 1892, stated that famine years in India were years of low supply in Egypt; and Sir J. Eliot, in his forecast of the probable character of the south-west monsoon of 1900, supports this.* His latest views on the Indian monsoon are fully set forth in his address to Section A (Sub-section, Cosmical Physics) of the British Association, 1904.† He considers that local or general drought in India may be due, among other things, to a larger diversion than usual of the monsoon currents to Burma or Abyssinia, and later he states that the Nile floods of the period 1895–1902 followed closely the variations of the rainfall in Western India, showing that the Abyssinian rainfall was more or less generally in defect, and most largely in 1899 and 1901.‡

Since the tropical rains are all caused primarily by the transfer northward of the equatorial rain-belt, followed by the northward extension of the south-east trade winds, it follows that probably a weakness of the winds in one area may also be felt in neighbouring areas in similar latitude. But there are other causes at work which affect the Nile

* *Nature*, August 23, 1900, p. 392.

† *Ibid.*, August 25, 1904, p. 399.

‡ This should be 1902; the 1901 flood, though below the mean, was much better than that of 1902.

flood and may cause it to depart from its usual agreement with the south-west monsoon of India. In the following table are given the

TABLE XVIII.

Year.	Ratio of Nile flood to mean flood.	Variation from normal of Indian rainfall.			Bombay rainfall— April-Sept.‡	S.W. monsoon rains.
		Year.*	June-Sept.§	June-Dec.		
		in.	in.	in.	in.	
1875	1·11	+ 2·38	—	—	+13·08	More abundant than usual, except in Bengal.
1876	1·10	— 4·49	— 3·4	—	−21·00	Very deficient, especially in Bombay.
1877	0·71	— 4·28	— 9·3	—	+ 1·40	Very deficient, except Burma.
1878	1·25	+ 6·34	+ 2·9	—	+ 41·71	Abundant, except Burma, N.W. Provinces, and Bihar.
1879	1·15	+ 1·69	+ 2·7	—	− 9·64	More or less above average.
1880	0·99	+ 1·55	− 2·6	—	− 3·10	Excess over N.E. India and Burma; defect over N.W. and Western India.
1881	0·64	+ 0·10	+ 2·4	—	+ 1·99	Excess, except in Madras, Mysore, and Assam.
1882	0·65	+ 2·64	+ 2·1	—	− 1·92	Deficient in N.E. India; excess over rest of India.
1883	1·05	+ 0·12	− 1·7	—	+19·05	Deficient, except Bombay and Central Provinces.
1884	0·84	+ 1·73	+ 2·5	—	+ 8·26	More or less in excess, except parts of Bengal and Assam.
1885	1·00	+ 1·05	+ 0·8	—	− 3·10	Deficient Bombay, Berar, Punjaub; excess elsewhere.
1886	0·92	+ 3·02	+ 1·4	—	+28·72	Moderate excess, except Central India and Central Provinces.
1887	1·21	+ 2·42	+ 0·1	—	+ 23·76	Practically normal.
1888	0·72	+ 1·54	+ 0·6	—	− 15·16	Normal or slight defect in India generally.
1889	1·00	+ 2·41	+ 3·3	—	− 3·26	Moderate to considerable excess, but defect in Sind and Punjaub.
1890	1·13	+ 0·68	+ 1·3	—	− 5·97	In excess generally; in defect in Burma.
1891	1·02	+ 3·54	− 4·9 †	− 4·25 *	+ 5·94	More or less in defect, except N.W. and Central Provinces.
1892	1·21	+ 5·09	+ 1·6 †	+ 5·69	+24·10	Slight to moderate excess over India.
1893	1·00	+ 9·07	+ 1·0 †	+ 4·72	− 4·13	Slight to moderate excess.
1894	1·23	+ 6·47	+ 4·4 †	+ 6·75	− 4·46	General excess, except east coast.
1895	1·16	+ 2·19	—	+ 1·95	− 3·49	
1896	1·03	+ 4·83	—	+ 3·59	+16·63	
1897	0·90	+ 0·15	—	+ 0·02	+10·51	
1898	1·07	+ 0·43	—	+ 0·93	+ 2·91	
1899	0·63	+ 11·14	—	− 11·34	− 36·68	
1900	0·90	+ 0·57	—	− 0·26	− 1·87	
1901	0·88	+ 4·13	—	− 5·12	—	
1902	0·64	+ 2·05	—	− 1·64	—	

* Eliot, 1875–1896, *Nature*, June 3, 1897, p. 110; 1897–1902, *Ibid.*, August 25, 1904, p. 403.
† Period June to October. ‡ *Ind. Met. Mem.*, vol. **14**. § *Ibid.*, vol. **6**, pt. ii. p. 110.

variations of the Indian rainfall from the mean, and also of the south-west monsoon for twenty-eight years, as well as short notes on the character of the monsoon rains for different years.‖

‖ *Indian Meteorological Memoirs*, vol. 6, part ii. pp. 109–110.

From this it is evident that the agreement is not invariable; in years of excessive precipitation, or of famine, the favourable or the unfavourable conditions will be at their strongest, and therefore will be most likely to extend widely. The test cases should be drawn from the years of more normal conditions. In these twenty-eight years, 1876, 1883, 1891, 1895, 1896 were above the mean in Egypt and below it in India, while 1881, 1882, 1884, 1886 were below the mean in Egypt and above it in India; thus nine years out of twenty-eight are not in agreement. Some do not differ widely from the mean, but they are not concordant, and show that the south-west monsoon is not by itself a safe guide to the character of the Abyssinian rains.

This investigation has now been carried further, and it has been found that a close relation exists between + and − anomalies of atmospheric pressure over Egypt and the neighbouring areas, and the defect or excess in the volume of the Nile flood. That such meteorological phenomena show a comparatively short period of oscillation has been pointed out by Sir J. Eliot, Sir N. Lockyer, Dr. W. J. Lockyer, Prof. Bigelow, and others. In the case of the Nile floods, local meteorological conditions affect this oscillation and increase the irregularity. Generally, then, it may be said that, so far as our knowledge goes at present, the Nile flood depends on, primarily, the strength of the monsoon air-currents from the Indian ocean, but modified by the pressure conditions which exist over North-East Africa, as I have shown in a recent paper.*

The following discussion took place:—

Sir Colin Scott Moncrieff: I do not know that I have much to say. I listened to Captain Lyons's paper and also read it with a great deal of interest. The way he is proceeding to show what does not cause the Nile flood is very satisfactory. By degrees we shall perhaps get at what does cause it. For a number of years I took the greatest interest in this matter, and these curves we have before us call back to my mind the way I made them out day by day, and kept the register of the Nile gauge for nine years. We got our readings every day from Khartum, from Berber, and from Wadi Halfa, until one fine morning the rain-gauge did not come in from Khartum, and it did not come in for about fifteen years, for the Mahdi was ruling the Sudan. After we first had our information cut off from Khartum, I tried to find if there was any connection with the rainfall at Zanzibar; but I could make nothing out of it. I was not encouraged at that time to believe there was much connection with the rains in India. We must just go on working, and by degrees I hope we shall get to the right thing. I am sure we are very much obliged to Captain Lyons, who has done more on this subject than all his predecessors put together.

Sir John Eliot: I might perhaps make one or two remarks. I am not quite certain whether there is some connection between the rainfall in India and in Abyssinia and the Nile regions, but I think it is only sufficient to mention the year 1899. The deficiency in India in 1899 was phenomenal. I have just heard

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* "On the Relation between Variation of Atmospheric Pressure in North-East Africa and the Nile Flood," *Proc. Roy. Soc.*, 1905.

from Captain Lyons that the Nile flood as indicated or measured by the gauge at Assuan was the lowest on record. The rainfall was deficient in the same year in the Mauritius, South Africa, and also in parts of Australia. I think that is quite sufficient to show there seems to be some very large connection between the rainfall in the whole of the Indo-oceanic area. I cannot give you data at present, and I can only give you that one case. In respect to the comparison with the rainfall in India, I would like to make one suggestion, as I have had something to do with drawing up the figures. There are two elements—first, as to whether you take your readings at a sufficient number of stations; and, secondly, whether you have rainfall data for a sufficient number of years to give you an approximate average for that area. I am not quite certain whether we have got to that stage in India as yet. When it comes to small variations for the whole of India, plus or minus, if you were to arrange the stations differently, it is very possible you would get different variations. For comparisons between rainfall variations in two areas, I should go more upon the correspondence of large variations than I should upon the correspondency of two curves. The only other point I wish to mention is the conclusion at which Captain Lyons arrives. He says, "Generally, then, it may be said that, so far as our knowledge goes at present, the Nile flood depends on, primarily, the strength of the monsoon air-currents from the Indian ocean, but modified by the pressure conditions which exist over North-East Africa." That is exactly what I have found for many years past in India, and of those two effects, the largest is produced by the Indian ocean. I think the paper is a most valuable one, and I only wish I had had the information contained in it five years ago.

Dr. W. M. Shaw: In relation to what Sir Colin Scott Moncrieff has said, we may find encouragement in the paper for meteorological work, from the conclusion that the flood conditions of Lower Egypt depend upon the rainfall in Abyssinia. The relation of conditions in Lower Egypt and in Abyssinia is easy to accept, because there is a river to connect them. There are connections in other parts of the world which really exist and deserve to be traced out, although one cannot point to a river on the map as the connection between them. For that reason we have reason to be grateful to Captain Lyons for the energetic way in which he is looking after his neighbours' observations. Observations are often taken with the understanding and the hope that they may be useful to other people, if not to ourselves. When that hope gets faint, there is a tendency for the observer to be discouraged. If Captain Lyons has done nothing else, he has shown that observations in widely different parts of the world may be of real importance to neighbours in the first place, and to the whole community in the second place. The determination of the relation or want of relation between plotted curves of variations of various elements from year to year is a subject that grows in importance as successive people take it up. It requires, I presume, an accomplished mathematician to deal with the curves and their periods, but our information is slowly accumulating, and I have no doubt that if we could get together a body of persons devoted to studying the relations of the meteorological phenomena of one country to those of others in the way that Sir John Eliot has suggested, and the India Office is, I believe, prepared to support, we should feel our gratitude to Captain Lyons strengthened by the fact that the observations he has organized, examined, and put together will contribute towards placing the relations between the meteorological conditions of different countries beyond cavil or doubt.

Colonel Hon. M. G. Talbot: I should like, as a late Sudan official, to testify to the thoroughness of Captain Lyons' work there. You have noticed, naturally, that all the data obtained in this paper has been obtained through the Egyptian and not the Sudan Government, and the same applies to the meteorological

data that Captain Lyons has collected and embodied in his other papers on the meteorological conditions of the Nile basin. The Sudan Government was sympathetic, but it had neither the money to provide the necessary instruments and observers, nor had it any one nearly so well qualified to undertake the superintendence as Captain Lyons. Captain Lyons and I have often corresponded regarding the observations, sending out instruments, and that sort of thing, and knowing well the great difficulties he has had to contend with, not only in the way of providing the necessary instruments, but in getting reliable observers in the Sudan, I can testify how entirely the collection of the meteorological data in the Sudan, so important for the study of the Nile flood, is due to his initiative and unceasing push and energy.

Dr. H. R. Mill: This paper is one which I think is of very special interest to this Society, because it brings to the solution of a geographical problem the facts that are ascertained by the study of another science—meteorology. In hearing this discussion of the Nile flood, the first idea, I think, that must come into the mind of any geographer is that the supposed importance of the Victoria Nyanza has been greatly diminished. I remember very well when we were endeavouring to start meteorological observations in tropical Africa, the work that Mr. Ravenstein took up with such energy and success there gave great hopes that the observations of rainfall round the great lakes were going to open a way to the solution of the problem of the changes in the floods of the Nile; this is now shown to be a mistake. The centre of the problem has been shifted back to the rainfall on the Abyssinian heights; and that this rainfall has the whole responsibility of producing the floods has been clearly brought out by Captain Lyons's paper. There is one fact on which he touched, but did not fully treat, that, I think, shows his estimate of the dependence of the floods on the Abyssinian rains to be almost numerically correct. When the variations in the height of the flood were expressed as a ratio to the mean flood, I noticed that these variations almost exactly correspond with the well-known variations of rainfall as they have been determined, not in this country only, but all over the world; that is to say, that the minimum year's rainfall is something approaching two-thirds of the average, and the maximum is something approaching one and a half times the average—rather more than twice the minimum. But a still more clearly established relationship with regard to rainfall averages is the average of the three dryest consecutive years that are likely to be experienced. The three dryest consecutive years in any period of thirty-five years and more have been found—and this relation holds in all parts of the world—to be about 80 per cent. of the true average fall. Now, I have looked at those figures of the Nile ratio here, and I find that the three dryest years, 1899, 1900, 1901, come out almost exactly with a ratio of 80 per cent. to the average, and that certainly would, on the face of it, suggest that the Nile flood is a direct measure of the rain of the district that produces it. I am not quite sure how far there may be variations in the evaporation; but I suppose that the climate of Abyssinia and the Sudan is so nearly invariable that there is not a very large difference between one year and another. It will be extremely interesting, and, I should say, absolutely necessary, to get observations set on foot in Abyssinia, so that we may have actual figures, and not merely indications, to go upon. And I think, from the energy with which Captain Lyons is pursuing his investigations in that direction, this result will be obtained before long. It would be a great thing if this Society and other learned societies could do something to help that forward. But a remark that fell from Sir John Eliot, I think, is more important than the establishment of isolated stations; that is, the comparative study of the results when obtained. Sir John Eliot laid stress,

wisely, on the extreme danger of deducing rainfall averages over large areas of country from an inadequate number of stations. His remark points to the necessity of using, not the station, but the area as the unit, and of studying the rainfall question from a geographical quite as much as from a meteorological point of view. I am now endeavouring to do this with regard to British rainfall. The number of stations, I am happy to say, is now about 4000, but even with all these the difficulty of ascertaining the relative wetness of different years in a long period is great, and it seems quite hopeless to attempt to do so by comparing any one individual station with another. The only way I see for getting the basis for a strictly scientific comparison of the variations of rainfall from year to year for the country as a whole, or any large region, is to work out the rainfall each year on different areas, and then by some method, either by arithmetical treatment or otherwise, get the averages for a long time.

Dr. HERBERTSON: I had no intention of speaking this afternoon, but I am very glad of the opportunity of thanking Captain Lyons for this most valuable contribution to a problem which has interested mankind for many centuries. It occurred to me during the reading of the paper and the subsequent speakers' remarks that it is very necessary that there should be some organization for discussing the meteorological observations in distant parts of the world. One would like to see a sort of International Meteorological Bureau, which would deal with meteorological observations from a selected number of stations for the whole world, and regularly discuss the world distribution of meteorological elements, their normal sequences and variations. In the case of the rainfall of Abyssinia, we obviously have to deal with pressure conditions where there is a baric ridge with sinking gradients to south and north. We want to know the normal conditions of pressure in this ridge and its slopes, the height of the barometer along the maximum area, and the relations to surrounding baric maxima and minima, and the depressions in the minima. That cannot be ascertained by one observer, nor dealt with satisfactorily by one of the ordinary weather bureaus. It requires a special bureau to discuss so large a question. Another matter which occurred to me was, how far the water of these Abyssinian rivers could be used for irrigation in the lower part of their courses before they reached the Nile, and how far that would affect the supply of water to the irrigation canals of Egypt. A last point is, may we not still see a great use in the equatorial rainfall and the Victoria Nyanza, and other lake basins, in keeping the level of the Nile constant during the winter months in Egypt, and so helping the perennial irrigation in the lower courses of the river?

Sir THOMAS HOLDICH: I am not an Egyptian official, neither do I belong to the Sudan, but as an outsider perhaps I may be allowed to give one little bit of evidence. In the year 1868 I was doing the best I could to survey the upper sources of the Atbara at the beginning of the monsoon season. You may remember, perhaps, that one of the main difficulties of effecting a dignified retirement from Abyssinia at the close of the expedition was the coming of the rains, which washed down with such force that in some of the narrower gorges the level of the water was raised 18 feet. You will admit, I think, that I was not at a bad point for observation, for there to the east we had the Red sea, with Annesley bay below us, and on the west the Nile basin leading to the Mediterranean. I am positively certain that on that occasion, at any rate, the commencement of the monsoon influenced both areas. The same wind, the same general lowering temperature, the same variations of weather which prevailed in the Red Sea at that time (and which were exceedingly inconvenient to the expedition), prevailed also on the Abyssinian plateau, and sent down floods to the Nile. From that day to this I have always believed the south-west monsoon to be the origin of rainfall

simultaneously in the Nile basin and in India, however unequally that rainfall may happen to be distributed.

Mr. CHISHOLM: The only observation I have to make on this very interesting paper is one suggested by something that has just been mentioned by Sir Thomas Holdich. It seems to me that one of the most important points brought before this meeting by the paper of Captain Lyons, viz. the fact that the floods of the Nile are mainly due to the drainage of the Abyssinian mountains, and not so much to the White Nile, is one that need not have excited, in the circumstances, any very great amount of surprise. Sir Thomas Holdich has just told us of the remarkably sudden rise of the rivers in Abyssinia, of which he had been a witness, and that induces me to ask him whether he can say anything with regard to the geological structure of Abyssinia; that is to say, whether Abyssinia is to a very large extent composed of a very hard rock—a hard impermeable rock that would not allow rain to sink in.

Sir THOMAS HOLDICH: Yes, it is so.

Mr. CHISHOLM: That being so, this structure, combined with the differences in altitude in Abyssinia, will have the effect that what rain falls there will find its way with remarkable speed into the mountain river, and ultimately cause a rapid change in the amount of flood in the Blue Nile at the junction of the White Nile. We know that in the Sudan the conditions are entirely different. We have there a vast alluvial country into which the rainfall will in a large measure gradually percolate into the streams, and in a large measure be brought to the surface again by capillarity and re-evaporated. Through such differences in physical conditions we have enormous differences in the behaviour of the rivers in different parts of the world. I believe, for example, it is the case that the maximum discharge of the Mahánadi may reach on certain occasions as high as that of the Ganges; but in the case of the Mahánadi the maximum may last for twelve hours, while in that of the Ganges it will go on for about three weeks, this difference arising from the fact that the Ganges flows through vast alluvial flats, whereas the Mahánadi flows through an area of hard crystalline rocks with steep slopes.

Mr. J. A. BAINES: Sir John Eliot has pointed out one instance of remarkable coincidence between the rainfall of Western India and the height of the flood on the Blue Nile, and there appears, also, to be a less marked but still perceptible instance of the same character in 1877. Both these, however, are in the direction of abnormal deficiency of rainfall, and to establish the fact that the influence of violent oscillations from the mean is common to both regions, it is necessary to ascertain that abnormal excess also is simultaneous. Perhaps Sir John Eliot, whose knowledge of the Indian monsoon is unrivalled, may be able to quote a year or two in which the fall, not merely on the west coast of India, but about 100 miles inland, was markedly above the average, so that we can see on the diagram whether a corresponding excess was recorded in the Abyssinian highlands. Another point which seems worth explanation is the very remarkable difference between the curve of quinquennial average variation on the Nile before and after the early seventies. The earlier curves appear to vary from year to year, whilst, of late, several years in succession seem to be subject to the same influence, and the curve is thus much more extended.

Captain LYONS: I am very glad Sir John Eliot agrees with me in my conclusion at the end as to the possible local effect on the variations of pressure. I may be over-sanguine, but my own feeling is, if we study the meteorology, not only of the Sudan, but of the other areas to the south, we may be able to form an estimate whether the rainfall in Abyssinia is likely to increase or decrease for a month ahead. This year a beginning was made, and rainfall was telegraphed

monthly from Uganda and British East Africa; in the latter area it was good, in the former poor, while on the Bahr-el-Jebel, particularly in April and May, it absolutely failed. The result was that the Sobat and the Blue Nile were nearly three weeks late in their first rise, as was to be expected. Dr. Mill spoke of the Victoria Nyanza as having been practically eliminated from the question, and asked about the effect of the Victoria Nyanza at the low stage of the Nile. Captain Owen, whose map was published in the *Journal* a short time ago, and also others, have told me there appears no doubt that the water-level in the Mruli-Foweira reach of the Nile is practically constant throughout the year, dry or rainy season, and the river is bank full there, so that the volume discharged is practically constant. Variations of discharge at the Ripon falls are regulated in the low marshy depression of Lakes Choga and Rawania. The discharge measured by Sir W. Garstin in March, 1903, below the Murchison falls, certainly was practically the same as that at Foweira at that season; that is to say, 550 to 560 cubic metres a second, constantly, throughout the year, represents the amount supplied by the Victoria Nyanza and its basin. The low stage of the Nile to which Dr. Herbertson referred raises another point. Throughout the year, at the mouth of the Bahr-el-Jebel, there is a constant discharge of nearly 300 cubic metres a second, because the marshes take up both the flood and the local rains of the summer. Therefore, adding the Bahr-el-Ghazal and Bahr-el-Zaraf, the constant discharge that goes down to the White Nile is about 400 cubic metres a second. The variable factors are the Sobat and the Blue Nile; if the rains are very heavy, and a certain amount is taken up in the soil, the springs are well filled, the rivers run down more slowly, and more water comes down the Sobat and the Nile in the winter. On the other hand, with moderate summer rains, which are continued, and even may become unusually heavy in September and October, although the flood may be a poor one, there may still be a good low-stage supply, because the Sobat and the Blue Nile are fed more than usual by the October rains. This happened in 1904, because the 1903 rains were continued well into September and October; exactly the opposite happened this year, when the 1904 rains failed in August, were very poor in September and October, and there was an extremely low-stage supply in consequence. With regard to the conditions of atmospheric pressure, to which Dr. Herbertson referred, I hope to publish something about that shortly. We have four years' observations for most stations, and two years for the others, our last station being within about 20 miles of the Uganda frontier. The main changes in the lines of the isobars appear to be, first of all, in the spring months, a low pressure forming over Abyssinia, which may have something to do with the quick advance of the early rains into Abyssinia. I am afraid, as regards the variation of the sharpness of the Nile flood curves, I am not able to give any explanation.

Sir Colin Scott Moncrieff: Might I ask a question? Supposing that the Victoria Nyanza was going down to Khartum, what would be the effect after that fills up the great spongy swamps? Is it not the case that in the month of March it is White Nile water, and not Blue Nile water, one is getting in Egypt?

Captain Lyons: There is a constant supply of about 300 cubic metres per second from the White Nile above the Sobat, plus a certain amount from the Sobat, plus a certain amount from the Blue Nile, and it is the last two factors that vary.

Sir Colin Scott Moncrieff: But the Blue Nile is not very much at that time, is it?

Captain Lyons: In a year of low supply it may discharge in May, but it is usually 300 cubic metres per second in the middle of January.

Sir Colin Scott Moncrieff: I was in Khartum the other day, and there seemed to be nothing at all.

Captain LYONS: In the previous autumn rain in Abyssinia was very deficient; therefore there was nothing to fill up the springs, and the Blue Nile ran down rapidly; the Sobat supplied little, but there was the same constant discharge above the Sobat junction. It is the extra supply that ordinarily comes at the low stage from Abyssinia which decreases in the years when either the whole rainfall has been feeble, or when the September and October rainfall has failed.

Sir COLIN SCOTT MONCRIEFF: The practical question we always wished to solve in Egypt was to find what sort of forecast we could have. As you say, I suppose it will be only by very careful examination of the great territories south of the Victoria Nyanza you will ever get at that.

Captain LYONS: Yes, probably by studying the rains as they extend northwards, together with the meteorological conditions existing over the western part of the Indian ocean.

Sir J. ELIOT: Is the Egyptian Service establishing any rainfall stations in Abyssinia?

Captain LYONS: We have had instruments for two or three years at Addis Abbaba, but they need replacing, and it is difficult to send them there safely. The Russians and the Italians are taking observations there also. Three or four rain-gauges have been sent to other places, but no returns have yet been received.

The PRESIDENT: In proposing a vote of thanks, I wish to say I am not myself a specialist on these points, therefore I can only give an outside view. It seems to me we owe Captain Lyons a debt of gratitude in three ways. In the first place for the positive information chiefly in regard to the real causes of the rise of the Nile, which have been so much in dispute for a long time; in the second place, for the negative portion of the paper, in which he disproves the relation, so far as we can see it, between the sunspot curves and the flood curves; and in the third place, raising the question of any relation between the flood in Abyssinia and the rains in India. I think that will give rise to much discussion. Altogether, I think it has been a most admirable paper, and has given rise to much interesting discussion.

SOME FURTHER NOTES CONCERNING THE LIAO HO.*

By Lieut.-Colonel A. W. S. WINGATE.

MR. ROBERT T. TURLEY contributes to the March number of the *Journal* (pp. 297–300) some interesting "Notes on the River System of the Upper Liao, Manchuria," accompanied by a "Sketch-map of the Liao River System," which, as the author justly says, should be of exceptional interest at the present juncture. With the object of maintaining that interest and of supplementing the valuable information contributed by Mr. Turley, the following notes have been written. Let me begin by calling attention to a few misconceptions in Mr. Turley's notes and map.

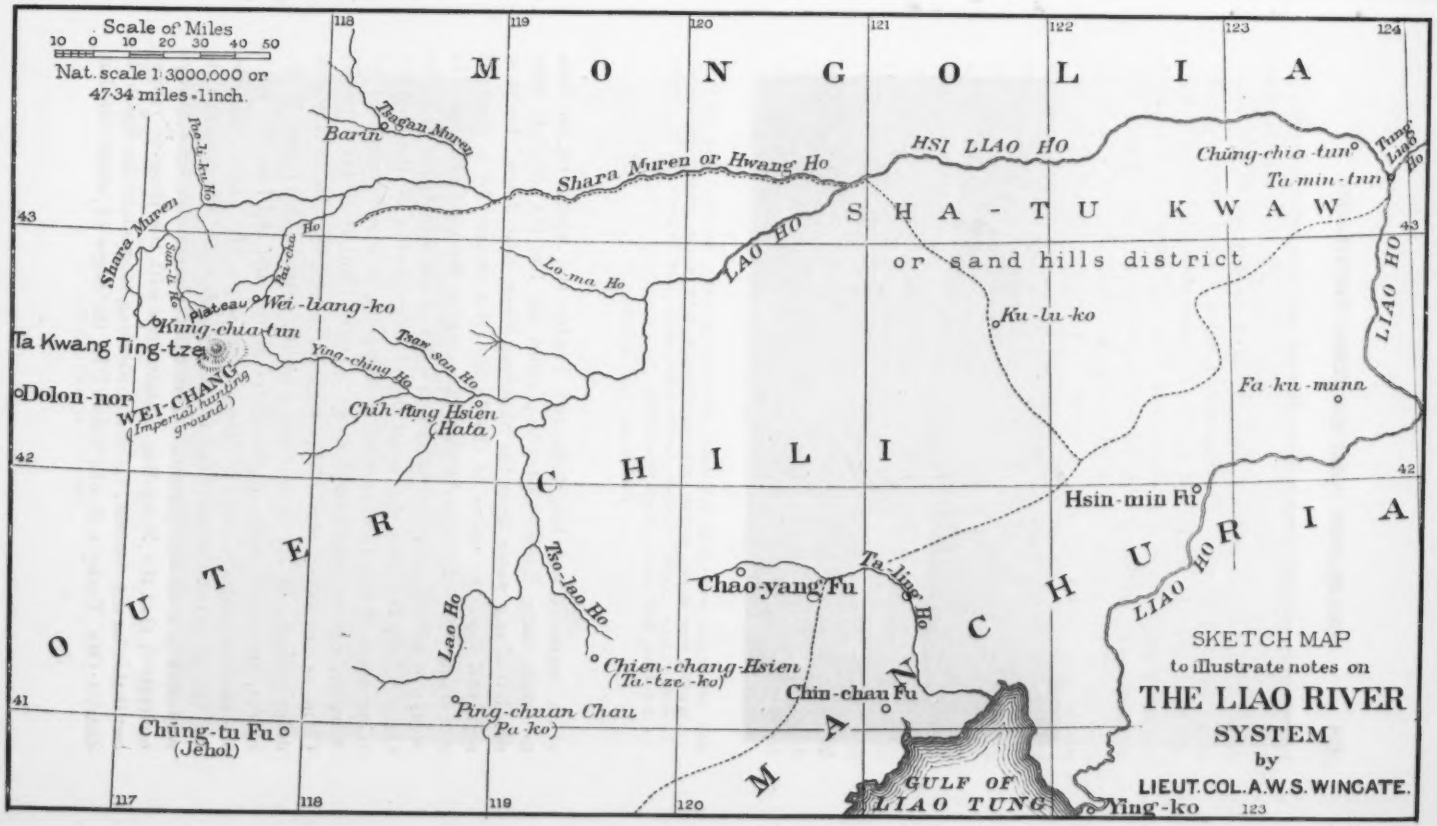
1. First and foremost as to nomenclature. I have been at some pains to discover the true names of the river in question, and my

* The latitudes and longitudes are approximate only, being derived from Russian maps checked by plane-table traverse. The exception is Hata, the data for which were furnished by Major Goold-Adams, R.A.

inquiries have resulted in this: that the Liao Ho (Ho is the Chinese for river) is known by that name only after the union of the Hsi Liao Ho with the Tung Liao Ho (East and West Liao rivers) at a place called Ta-min-tun, about 65 miles a little east of north from Fa-ku-men; this is Mr. Turley's Liao Ho. With the eastern branch I shall not concern myself at present. The Hsi Liao, or Western Liao, is known by that name from the time it leaves Manchuria until its junction with a river of many names and spellings, but known to the local Chinese as the Hwang Ho, and to the Mongols as Shara Muren, both names signifying "Yellow river," after the colour of the water. I shall have more to say about this stream later. From this point (*i.e.* the junction of the above two rivers) our stream becomes the Lao Ho of the Chinese and the Laocha Muren of the Mongols. Thus Mr. Turley's Liao Ho includes the Shara Muren, Lao Ho, Hsi Liao Ho, and Tung Liao Ho, which, all united, form the Liao Ho of Manchuria; the first-named three being in Mongolia and Chili province. It is, therefore, the lower rather than the upper Liao which lies in Manchuria.

2. The headwaters are composed of quite a number of streams, though there are two main sources—the Lao Ho, which rises, as Mr. Turley says, just north of the 41st parallel and just east of the

A PORTION OF THE PAI-CHA PLATEAU, AND SOURCE OF PAI-CHA RIVER.
(*Photo by Lieut. H. J. Doveton.*)


Scale of Miles
10 0 10 20 30 40 50
Nat. scale 1:3,000,000 or
47·34 miles = 1 inch.
MONGOLIA
Barin
Tsagan Muren
Shara Muren or Hwang Ho
HSI LIAO HO
Chung-chia-tun
Tung Liao Ho
Ta-min-tun
SHA-TU KWAW
or sand hills district
LAO HO
LIAO HO
Lo-ma Ho
Ku-lu-ko
Fa-ku-munn
Shara Muren
Sun-ti Ho
Pai-cha Ho
Pai-li-ku Ho
Plateau
Wei-liang-ko
Kung-chia-tun
Ta Kwang Ting-tze
Dolon-nor
WEI-CHANG
(Imperial hunting ground)
Ying-ching Ho
Tsar-san Ho
Chih-fung Hsien
(Hata)
CHILI
OUTER
Hsin-min Fu
MANCHURIA
Tso-lao Ho
Lao Ho
Chao-yang Fu
Ta-ling Ho
LIAO HO
Chien-chang-Hsien
(Tu-tze-ko)
Chin-chau Fu
Ping-chuan Chan
(Pu-ko)
Chung-tu Fu
(Jehol)
GULF OF
LIAO TUNG
Ying-ko
SKETCH MAP
to illustrate notes on
THE LIAO RIVER
SYSTEM
by
LIEUT. COL. A. W. S. WINGATE.

THE NORTHERN WEI-CHANG (IMPERIAL HUNTING-GROUND), SHOWING THE COUNTRY WHERE THE SHARA MUREN AND TRIBUTARIES TAKE THEIR RISE. THE PHOTOGRAPH WAS TAKEN LOOKING NORTH-WEST FROM THE SUMMIT OF TA KWANG TING-TZE, 6000 FEET ABOVE SEA-LEVEL.

(*Photo by Lieut. H. J. Doveton.*)

118th degree of east longitude, and Tso-lao Ho, which begins close to Chien-chang Hsien (Ta-tzu-ko). But the Lao Ho certainly does not derive any water from the "hunting forest near Jehol," for it is separated from the valley of the Je Ho (Hot stream) by a range of mountains which Dr. Franke calls Yung-an or Mu-yu mountains. It would be more accurate nowadays to speak of the Lao Ho as rising in Outer Chili, the time for speaking of any portion of the country lying south of the 43rd parallel as Mongolia, or a land inhabited by Mongols, having long passed away. Outer Chili is to-day as much China as any other part of the eighteen provinces. Its inhabitants differ scarcely at all from those dwelling within the Great Wall; indeed, the north banks of the Shara Muren and Hsi Liao Ho mark the modern southern limit of Mongol territory. Mr. Turley says the Lao (or, as he calls it, the Liao) Ho loses much water "as it wends its way slowly over the plateau." But what plateau? I have always understood that the Mongolian plateau ends with the Hing-an range; but if this be not the case, yet is it misleading to speak of the Sandhills district (Mr. Turley's Sha-tu Kwaw), on the edges of which the Lao

Ho, Shara Muren, and Hsi Liao Ho undoubtedly do lose much water as a plateau.

3. Mr. Turley goes on to say, "Until it enters Manchuria it passes only one town, Bada, a noted barter-market." Now, if Hata or Chih-feng Hsien (its Chinese name) is on the Lao Ho, or the Hsi Liao Ho, or any other river of like name, then every map in existence is wrong! Mr. Turley's map is somewhat out in this direction. The town in question is in lat. 42° 18′ 40″, long. 118° 50′ 30″ E., on the Ying-ching Ho, an important tributary of the Lao Ho, 130 miles long, whose headwaters are to be found in the north of the Wei-chang (Imperial hunting-ground) on the slopes of the very mountain (Ta Kwang Ting-tze, the same, I believe, as Dr. Franke's Tuchte, and not improbably Huc and Gabet's Sain-oula, or Good mountain) which has for centuries formed a kind of will-o'-the-wisp to travellers and sportsmen engaged in looking for Verbiest's and Gerbillon's 10,000 feet high Pai-cha (Pei-sha or Pétcha). I am thankful to say we have at last run that phantom to earth. The region is extremely interesting, not only to geographers and sportsmen, but also to the naturalist and botanist, and merits a paper to itself. Here I will only say that there is not a single peak of the Hing-an range south of the Shara Muren which overreaches 6600 feet above sea-level.

THE SHARA MUREN, ABOUT 30 MILES FROM ITS SOURCE AND 20 MILES ABOVE ITS JUNCTION WITH THE PAO-LI-KU HO, FROM WHICH THIS CLEAR WATER DERIVES ITS YELLOW TINGE. LOOKING EAST DOWN RIVER.

(*Photo by Lieut. H. J. Doveton.*)

THE HWANG HO OR SHARA MUREN 15 MILES ABOVE ITS JUNCTION WITH PAI-CHA-HO. LOOKING WEST UP RIVER.

(*Photo by Lieut. H. J. Doveton.*)

4. Thanks to the "Boxers," our knowledge of these regions is not so "vague and uncertain" as it was prior to 1900. The disappearing rivers are common enough and easily accounted for, but the "intermittent springs" sound interesting, and one would like to hear more about them. The "Ta-miao Ho" is not marked on any map in my possession, but is possibly the Yang-hsi-mu Ho (Dr. Franke's Yang-sheng-mu) with its tributary the Hsiao-shwei Ho. As to "Ku-lor," it is impossible to know which place is meant, as it is not marked on Mr. Turley's map. It may be Ku-lu-Kou, Ku-lien-erh, Ke-li-kê, or a host of similar-sounding places.

5. Certainly the geologist would find much to interest him in the country drained by the Lao Ho and Shara Muren and their tributaries; but I am inclined to doubt the likelihood of a former "highly civilized race" having done much building in these regions prior to the rise of the Manchus to power. Perhaps researches conducted like those of Dr. Sven Hedin in Central Asia might produce something of interest.

6. Mr. Turley thinks "the most northern bend of the Liao, which is formed by the junction of the Lao Ho (Khe) and Sira Muren (or upper Liao), is fully 100 miles due north of the position allotted to it on most maps. . . ." The statement that the Sira Muren is identical with the upper Liao is a geographical error, as, of course, such is not

the case. The Sira Muren (Shara Muren, Shira Muren, Hsi-la-mu-lan, or Hwang Ho) is the most important tributary of the Hsi Liao Ho, and rises on the north-western slopes of the plateau which forms what is generally known as the Pai-cha district. But if we call it by its Chinese name, Hwang Ho, then undoubtedly its source is the Pao-li-ku Ho, which, rising in the hills north of Chin-p'eng, flows south for 25 miles, and then turns sharp to the east on meeting the Shara Muren. The reason for this conclusion is that, above the point of junction the latter river loses its yellow tinge and becomes clear water. The headwaters of the Shara Muren and Sun-li Ho (a branch of equal

THE HSI LIAO HO NEAR CHUNG-CHIA-TUN, AFTER IT HAS LOST MUCH WATER IN THE SHA-TU KWAW (SANDHILLS DISTRICT). BRIDGED BY A SINGLE BOAT. ABOUT 20 MILES DOWN RIVER FROM HERE IT JOINS THE TUNG LIAO HO.

(Photo by Captain F. E. Gunter, R.A.M.C.)

BOATS ON THE LIAO HO, WHICH REACH TUNG-CHIANG-TZU.

(Photo by Captain F. E. Gunter, R.A.M.C.)

THE MANCHURIAN LIAO HO AT YING-KO (TREATY PORT). LOOKING UP RIVER AT SUNSET.

(Photo by Captain F. E. Gunter, R.A.M.C.)

length and greater volume) all lie within a day's march of each other in lat. 42° 40′, long. 117° (about). It may be as well to say here, for the benefit of future travellers, that the Dolon Nor and Ch'ang-tu Fu sheets of the new (1904) German 1 : 1,000,000 map are very misleading in a good many places.

Mr. Turley is quite correct in saying that the most northern point touched by the Hsi Liao Ho is shown too far south on the maps of the day. The mistake has arisen from supposing the small stream which joins the Liao Ho about 15 miles north of Fa-ku-munn (shown on Mr. Turley's map, but without a name) to be the real Hsi Liao Ho, which, uniting with the Tung Liao Ho (Mr. Turley's Liu-chia Ho Yen) at Ta-min-tun (lat. 43° 23′), form together the Liao Ho of Manchuria. But Mr. Turley has gone to the other extreme by placing the highest point at 43° 50′, whereas 43° 35′ is about the maximum. In fact, the Shara Muren and Hsi Liao Ho, between E. longs. 118° and 123° 40′, follow, roughly speaking, a course between lat. 43° 15′ and 43° 35′.

Mr. Turley says, "No boats are allowed above Tung-chiang-tzu" (the port of Fa-ku-munn, from which it is distant about 15 miles). This is, I think, not quite accurate. I have heard that fair-sized boats reach Ta-min-tun, 65 miles higher up, and that very shallow boats get 16 miles further, to a point within 3 miles of Chung-chia-tun (lat. 43° 28′ approx.).

7. With respect to the course of the Liao Ho proper, in its passage through Manchuria to the sea, I have nothing to add to Mr. Turley's first-hand information. There are certainly no bridges over these rivers at present existing, though it would be easy enough to make them in certain spots. But that good stone bridges existed at one time

over some of their tributaries, is demonstrated by the artistic photograph in Dr. Franke's well-known work, 'Beschreibung des Jehol-Gebietes in der Provinz Chihli,' of a stone bridge over the Tsagan Muren, a tributary of the Shara Muren which drains the Barin country.

THE FIELD OF GEOGRAPHY AND SOME OF ITS PROBLEMS.*

By Rear-Admiral Sir W. J. L. WHARTON, K.C.B., F.R.S.

It is sometimes denied to Geography that she has any right to consider herself as a science, the objection being apparently founded on the view that it is a subject that can be learnt by heart, but not studied on any systematic line or reduced to principles which enable advance to be made, as in the more exact sciences, by continual investigation by means of laws discovered in the course of such investigation. This, it appears to me, is a misapprehension due to an incomplete recognition of what science is, and of what geography is. Science is, in its simplest interpretation, "knowledge," such knowledge as comes from an intimate acquaintance with and study of any subject duly co-ordinated and arranged. The subjects which the advancing education and civilization of the world have caused to be minutely studied are very many, and as knowledge has increased specialization has become a necessity, until the list of sciences is very long.

Science may be broadly divided into several categories. Pure or Exact Science, such as mathematics; Natural or Physical Science, which rests on observations of nature; Moral Science, which treats of all mental phenomena. Some sciences are of ancient foundation, some have arisen from new inquiries and needs of man, or from fissure in subjects too wide for convenient treatment as one. Many of them are capable of exact definition, and their boundaries and limits can be well marked. To others no very distinct limitations can be assigned. From their nature they overlap and are overlapped by other subjects, and it is impracticable to confine them by a strict line. Geography is one of the latter.

Geography is one of the most ancient subjects studied with a view of co-ordinating facts. A desire for exact knowledge of, first, the bearings and distances of one place from another for the purposes of intercommunication must have arisen as soon as men became collected into groups whose growing civilization and needs required travel to obtain what could not be obtained in the community. This was the earliest form of geography, and it is an aspect which still remains, and to some is, in the modern shape of maps, the principal, if not the sole, end of geography.

From the earliest times, however, geographical information included other than topographical data. It was soon found that for the traveller and statesmen, whether in peace or war, more was wanted to enable geography to supply requirements. The nature of a country, the supply of food and water, the character of the rivers, the manners and customs of the inhabitants, their language and affinities, the climate, and other matters, were all of much moment, and geography dealt with them all, being, as its name denotes, in the broadest sense a "description of the earth."

After the first crude guesses of relative positions, founded on times occupied on journeys, other knowledge was enlisted in the cause. Astronomy was soon

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* Presidential address to the Geographical Section of the South African meeting of the British Association, Cape Town, August, 1905.

recognized as the only means by which to ascertain the distances of places far apart and separated by seas, but for many centuries this could only be applied to latitude. Still, the scientific geographer had to study and use the astronomical and geodetic methods known. As knowledge increased, the subjects became too wide to be strictly considered as one study, and many have become the objects of special research under different titles.

Geodesy deals with the precise form of the Earth and its dimensions. *Geology* studies the nature of the materials forming the Earth's crust, and the changes in it in past ages. *Ethnology* and *Anthropology* treat of the different races of mankind. The study of *Economics* takes note of the conditions of communities and nations, their laws and systems of government. *Botany* and *Zoology* now concern themselves with the details of vegetable and animal life. *Archæology* investigates the remains of past civilizations which cover the Earth. *Meteorology* strives to unravel and reduce to law the complicated conditions of the atmosphere, its continual movements, and the results which have such varying effect on our daily life. *Oceanography*, the study of the phenomena of the sea as distinct from the dry land, is still regarded as an integral part of geography, but is rapidly becoming a subject by itself.

Of all these subjects geography may be considered to be the parent; and though the family may be large, and has gone off on many separate lines, it is necessary when taking a large and comprehensive view of the united results of knowledge thus gained, especially from the point of view of distribution, to return to that parent and consider them on a general or geographical basis.

I cannot pretend to define Geographical Science in a clearer or shorter form than that in which it has been already put by General Sir Richard Strachey, and I will quote his words:—

"To investigate and delineate the various features of the Earth, to study the distribution of land and sea, and their effects upon climate, the configuration and relief of the surface, positions on the globe, and so forth, facts which determine the existent conditions of various parts of the Earth, or which indicate former conditions, and to ascertain the relations that exist between those features and all that is observed on the Earth."

Strabo, in the opening words of his introduction to his great Geography, puts it thus:—

"If the scientific investigation of any subject be the proper avocation of the philosopher, geography, the science of which we propose to treat, is certainly entitled to a high place. In addition to its vast importance in regard to social life and the art of government, geography unfolds to us the celestial phenomena, acquaints us with the occupants of the land and ocean, and the vegetation, fruits, and peculiarities of the various quarters of the Earth."

This was written when geography included all natural science, and before it gave birth to so many separate subjects; but it sets forth admirably the aims which the geographer still pursues that it is worthy of remembrance. It is not advocated, nor is it in any way necessary, that all should study geography in the extended sense thus indicated; but it cannot be too strongly pointed out that an educated man—and education is now essential to the successful conduct of affairs—must have a considerable knowledge of the elementary facts of geography.

These elementary facts are, it is true, of the nature of a lesson, and must be learnt, so to speak, by heart by the aid of maps and books; but this is nothing more than making use of the labours of others without which no advance is possible in any subject, and is common to all studies. We must, in fact, distinguish between the science of geography, which consists in ascertaining and co-ordinating

new facts, and putting them into a shape for the use of others, which is the work of comparatively few; and the practical geography which consists of making use of that work, and which, as in many other branches of science, is within the reach of all who choose to devote time to it.

It is the object and business of the British Association to try to interest their fellow-countrymen in all branches of knowledge, to gain if possible more workers in science, but at any rate to induce all educated persons to take advantage of the solid work done by others towards the elucidation of the details of the glorious Nature which surrounds us on all sides, and in so many forms, and without which ignorance and superstition, those primary bars to the advancement of mankind, can never be banished. It is impossible to have a clear comprehension of history whether past or present, without calling in the aid of Geography; but unfortunately much history has been written and taught without such aid. To read the daily paper requires either geographical knowledge or constant reference to maps; and if readers would only make a practice of such reference on every occasion when at fault, they would soon find themselves acquiring knowledge of the greatest use to them in the easiest and most interesting manner, and with the smallest expenditure of time. The mistakes made even by those responsible for the conduct of public affairs, by reason of the want of this essential but elementary knowledge, are innumerable, and to this day there are many who consider themselves highly educated and capable men who cannot even rightly understand a map. As I have before indicated, good maps are the foundation of all sound geographical knowledge, and these maps must be founded on good surveys. Now a good survey is a comparatively modern operation, and the parts of the world that have been subjected to it are small indeed. It is true that we now have general maps of the larger parts of the world, which more or less convey a fair representation of the configuration of land and sea when large areas are considered, but details are sadly lacking almost everywhere. It is not astonishing, for to make the necessary surveys requires an enormous expenditure of both time and money, and the latter is hard to get until the necessity for its expenditure is patent to the smallest intelligence. Thus many countries long settled and in a high state of civilization are still without any organized system of survey or maps, and even in the United Kingdom it is only from the year 1784 that a proper survey was established of the British Isles, though no maps were published from it until 1801; and it has proceeded so slowly that it has only recently been in one sense completed, while its revision, badly wanted on account of changes, is still in active prosecution, and must be continued *ad infinitum*. Such indifference is, however, giving way to experience of the results of absence of proper maps, and all who wish well to the progress of South Africa must be pleased at finding that their provision has been taken in hand on such an admirably scientific basis as is provided by the Trigonometrical Survey, now far advanced, and the successful progress of which is, I believe, greatly due to the inexhaustible energy of my friend Sir David Gill, who seems to find time to promote and aid all branches of knowledge, and that steps are now being taken to prosecute the detailed topographical survey and provide good maps.

To many people one map is as good as another. They do not pause to consider on what it is based, or what degree of accuracy it probably possesses, but so long as there is a map they are satisfied. A vast number of existing maps are compiled from the roughest materials: in partly occupied countries, from drawings of small areas placed together as can best be done, by means of places here and there whose relative positions are fairly known by distances along roads, with perhaps in some cases angles and astronomical positions; in less civilized parts by routes of travellers laid down by estimation of the distance traversed and direction of

march, checked perhaps by a few astronomical observations of more or less value as the traveller possesses or does not possess the necessary skill. The compilers of such a map have a difficult task. Discrepancies are, of course, multitudinous. Nothing agrees, and one has to accept, reject, and adjust as best he can on his own responsibility and with what knowledge he can procure of the respective reliability of each author. Happy is he if he has even a few positions in his map which have been properly determined, as between them he is saved from the constantly increasing errors of adding one little area to another, which if carried on indefinitely culminates in great errors. Of course such maps are of no practical use, save as giving a very general idea of a country, and when required by the administrator or traveller lead to endless mistakes and annoyances.

The feature of our globe which is now, broadly speaking, most accurately laid down is the coast-line. The safety of navigation has caused general marine surveys to be carried on all over the world during the nineteenth century, which have finally determined the position and shape of the boundaries of the sea. These surveys, executed for the most part by skilled naval officers with proper instrumental outfit, and supplied especially with reliable chronometers, and based upon frequent carefully determined astronomical positions, have resulted in this boundary line being delineated with an accuracy, so far as its absolute position is concerned, far in advance of any other main feature in maps. Here I may perhaps explain to those unversed in these matters why this is so.

The position of any spot on the earth's surface can be ascertained in two ways: either by careful measurement by means of an accurate system of triangles from another spot already fixed, or by independent observations of the heavenly bodies and calculations from them, which give the precise latitude and longitude of the place. The former is suitable for positions inland, but entails much time and labour, and is only adopted when a perfect map is to be made, for which it is the indispensable foundation. The latter can be carried on from a ship, and under most circumstances only from a ship, because of the limitations of the methods of determining longitudes. Longitude can now be satisfactorily and rapidly ascertained in two ways: by the electric telegraph, or by use of chronometers. The places served by the electric telegraph are still few, and its use is therefore restricted: but the chronometer has been in working use for over a hundred years. This instrument, which is merely a watch of especial construction, will only keep a steady rate when it is undisturbed by irregular shocks or motions. No means have yet been found for transporting a chronometer on land without upsetting its regularity, and therefore rendering it useless; but on board a ship it can be so suspended and stowed as to prevent its being disturbed by any ordinary movements of or in the ship. The accurate time of any place departed from, ascertained by astronomical observations, can therefore be carried about on board ship for considerable periods, and by comparison with the local time, also determined by sextant observations of the heavenly bodies, at any required spot on the coast, the difference of longitude is at once obtained with very small limits of error when a number of chronometers are employed. These two simple yet marvellous instruments, the sextant and the chronometer, have thus placed in the hands of sailors ready means of fixing with great exactitude and celerity the position of selected points on coasts all over the world; and it will be seen that, while the detail of the line of coast between such fixed positions will depend upon the degree of accuracy of the survey or sketch, the general lines cannot get far out, as it is constantly checked at the selected points. It is not claiming too much to say that at the present time very few salient points on the coast-lines of the world are as much as two miles in doubt.

It should be a source of great satisfaction to the Briton to know that both these instruments were devised by Englishmen, John Hadley producing the sextant in 1730, in the form still used, on the basis of ideas formulated by Newton fifty years before; and John Harrison the chronometer in 1736. The latter instrument has undergone modifications in detail, but the principle remains the same. It required seventy years before its value was fully recognized and it came into general use. It is a still further satisfaction to think that it is British naval officers who have made by far the greatest use of them in mapping the coasts of the whole world. Since the time of the great Captain Cook British surveying vessels have been constantly employed in this work, not only in British colonies, but in all parts, aiding and often paving the way for British commerce, and for the men-of-war that protect it.

It is difficult to find coasts of any extent that have not been laid down by British marine surveyors. The whole of Africa has been their work. By far the greater part of America, all the south and east coasts of Asia, Australia, and most of the innumerable islands in all oceans have been fixed and laid down by them. Even in the Mediterranean, till very lately, the charts were mostly founded on British surveys, and the improvements now being carried out by other nations on their own coasts in details required for modern navigation do not materially modify the main shapes and positions formerly determined by the British. It has been, and is, a great work, and I hope I may be pardoned for dwelling on it with pride as the result of the wise administration of the Admiralty for many years, and of the immediate labours of my predecessors as Hydrographer, and as a very great contribution to geographical knowledge, more especially as I do not think that it is generally realized that this great advance in geographic accuracy is due to marine surveyors.

To give an idea of the comparative accuracy of the chronometer method, I may mention that on taking at hazard eleven places distributed all over the world at great distances from England, whose longitudes have been recently determined by means of the electric telegraph and elaborate series of observations, I find that the average distance between the chronometer and the telegraph positions is 700 yards. The shapes of the different continents and the positions of islands as at present on our maps and charts will never be altered except in insignificant degree, and the framework is ready for many years' work of land mapping. It is not to be inferred from what I say that marine surveys are approaching their close. It is far otherwise. The time given to these enormous extents of coasts and seas, and the necessarily small scales on which the surveys have been carried on, have caused them to be very imperfect in all details. Hundreds of rocks and shoals, both stretching from the land and isolated in the sea, have been missed in the course of them, and loss of ships and life on these unknown dangers still continues. With the increase of shipping, increased number of ships of heavy draught, the closeness of navigation due to steam, and the desire to make quick passages, smaller inaccuracies of the charts become yearly of greater importance. As an illustration of the condition of affairs I may mention that in Hamoaze, the inner harbour of Plymouth, one of the headquarters of the British fleet for over 300 years, a small but dangerous pinnacle of rock was only discovered five years ago; whilst numerous other dangers of a similar character have been yearly revealed in close surveys of other harbours in the United Kingdom, supposed to be well examined and charted in the last century. There never was a greater need for close marine surveys of places frequented by ships than now.

It is interesting to look back and see the gradual progress of the delineation of the world, and to mark how very recent any approach to accuracy is. The very

earliest maps of any extent of country are unfortunately lost to us. The first man who made a map of which any historical record exists is Anaximander of Miletus, about 600 B.C., but we know nothing of it. A map is mentioned by Herodotus as having been taken in 500 B.C. by Aristagoras of Miletus in the shape of an engraved bronze plate whereon the whole circuit of the earth was engraved, with all its seas and rivers, to influence Cleomenes, King of Sparta, to aid the Ionians against Persia. This was probably the work of Hecatæus, to whom early geography owed much. His works are also only known to us by quotation; but they are especially interesting as containing an early idea of the limits of Africa, which he represents as entirely surrounded by the sea—a circumstance apparently either forgotten or disbelieved in later years. Erotosthenes, 250 B.C., and Hipparchus, 150 B.C., made great advances, and the former made the first attempt to measure the size of the earth by the difference of latitudes between Assouan and Alexandria in Egypt, an attempt which, considering the great imperfection of his means, was remarkably successful, as, assuming that we are right in the length of the stadium he used, he made the circumference of the globe 25,000 geographical miles, whereas it should be 21,600. He also devised the system of meridians and parallels as we now have them; but the terms "latitude" and "longitude," to denote positions on those circles, were introduced by Ptolemy.

The maps of Ptolemy, the great Alexandrian astronomer and geographer of A.D. 150, are the earliest we possess. He drew, besides a general map of the whole known world from the southern part of the Baltic to the Gulf of Guinea, north and south, and from the Canary islands to the China sea, east and west, a series of twenty-six maps of the different parts. Ptolemy's maps, and his method of representing the spherical globe on a flat surface, had a great influence on geography for many years. After his time the Greek civilization waned, and the general decline of the Roman Empire, followed by its disruption by the invasion of the barbarians, closed the course of discovery in all branches of research for centuries. It is not too much to say that for 1300 years no advance was made, and until the commencement of exploration by sea, which accompanied the general revival of learning in the fifteenth century, Ptolemy's maps represented the knowledge of the world. As might be expected, the further he got from the Mediterranean, the greater were his errors; and his representations of Eastern Asia and North-Western Europe are somewhat grotesque, though quite recognizable in the main. Of Africa south of the Equator he knows nothing, and his map of it terminates with the border. This is somewhat remarkable, as I am one of those who firmly believe in the circumnavigation of Africa by the Phœnicians sent by Necho, King of Egypt, in 600 B.C., from the head of the Red sea. As described by Herodotus, the voyage has all the impress of veracity. My personal faith in Herodotus was much strengthened by finding when I surveyed the Dardanelles in 1872 that his dimensions of that strait were nearer the truth than those of other and later authorities, even down to the time at which I was at work, as well as by other geographical tests I was able to apply. When, therefore, he records that the Phœnicians declared that in their voyage they had the sun on their right hand, and says he does not believe it, he registers an item of information which goes far to prove the story correct. Influenced by Hecatæus, who though surrounding Africa by the sea cut it far short of the Equator, Herodotus could not conceive that the travellers had passed to the south of the sun when it was in the southern tropic.

No historical incident has been more discussed than this voyage, commentators varying much in their opinions of its truth. But we have to-day some new facts. No one who has followed the exploration of the ancient buildings in Rhodesia, and considered the information we possess on the early inhabitants of Southern

Arabia, whether we call them Sabæans or Himyarites, can doubt that the former were mainly the work of men coming from Arabia at a very early date, while the period of time necessary to carry out gold-mining operations over the large areas now found to have been exploited must have been very great. It seems strange that no record of the constant voyages to this El Dorado should remain, but the very natural desire to keep lucrative information to themselves is not an unknown thing amongst traders of the present day, while the conditions of society and the absence of written records of South Arabia would make concealment easy. The Phœnicians, an allied race, and the great seafaring trading nation of the Mediterranean, succeeded in keeping the majority of their marts secret, and we have incidents recorded showing their determination not to allow others to follow their steps, while to this day we are very doubtful of the limits of their voyages. It may be considered certain that while we naturally quote Greek historians and geographers as the early authorities for the growth of geographical knowledge, and that the scientific basis for proper maps of large areas was really provided by them, the seafaring nations, Arabians, Phœnicians, and Chinese, knew a very great deal practically of the coasts of various parts of the Old World that were absolutely unknown to the Greeks.

The favourable conditions afforded by those remarkable periodic winds, the monsoons, would in the China sea, Bay of Bengal, and the Arabian sea, naturally facilitate any attempts at extensive sea voyages, and would lead to such attempts under conditions that in the regions of variable winds would be considered too dangerous and uncertain. The fact that the monsoons in nearly every case blow practically parallel to the coasts in opposite directions is a most important factor in considering early navigation. The direction of the wind itself in such cases roughly guides a vessel without a compass, and the periods of cyclones and unsettled weather between the monsoons would soon be noted and avoided, as they are to this day by the Arabs and Chinese, whose vessels, I have very little doubt, have remained practically the same for thousands of years.

The unknown Greek author of that unique and most interesting document, the 'Periplus of the Erythræan Sea,' probably of the first century A.D., describes vessels built without nails, whose planks were bound together by cords, in precisely the same way as many Arab dhows now navigating the Indian ocean. His personal knowledge of Africa evidently ceased at Cape Guardafui, though he gives information gained from others on the east coast as far as Zanzibar, which—or, rather, a part on the mainland near—he describes as the limit of trade to the south. We know that Arabs had penetrated further, but no doubt they kept their knowledge to themselves. These early navigators very probably had charts. When Vasco da Gama first passed along the eastern coast of Africa he found that the Arab dhows had charts. Unfortunately none of them has come down to us, or it would have been interesting to compare them with those of the west coast used by the Portuguese at the time, and which were of the crudest description.

I claim for sailors of all ages that they would be the first to make practical maps of the shape of the coasts. Their safety and convenience demanded it, while it is a far easier task to compile such a picture of the earth from successive voyages along coasts over the sea, where average distances from known rates of sailing and courses from the sun and stars can be more accurately ascertained than from long and generally tortuous land journeys in directions governed by natural features, towns, and so forth. A navigator *must* be a bit of an astronomer. A landsman to this day seldom knows one star from another. It was the sea-charts, or *portolani*, of the Middle Ages that on the revival of learning first gave respectable representations of the shape of the coasts, at a time when the learned monks and others

were drawing the most fantastic and absurd pictures which they called maps. At the same time it must be remembered that in all ages and down to the present day pilots, who within a hundred years were usually carried by all ships, even for sea voyages, jealously keep their knowledge largely in their heads, and look upon good charts as contrivances to destroy their profession, and that such charts or notes as they had they would keep religiously to their fraternity.

The Egyptians were no sailors, but we know that they habitually employed Phœnicians for sea expeditions, while we have the historical record of the Old Testament for their employment by David and Solomon for a like purpose in the Red sea, and probably far to the south. It is, therefore, almost impossible to doubt that the Phœnicians were also acquainted with the navigation of the Red sea and east coast of Africa. Such a voyage as that recorded by Herodotus would under these circumstances be far from improbable. The varying monsoons, which had led the Arabians centuries before to get so intimate a knowledge of the east coast as to enable them to find and work the gold-fields, would be well known to the Phœnicians, and the hardy seamen who braved the tempestuous regions lying between Cadiz and Great Britain would make little of the difficulties of the African seas.

The limit of easy navigation from and to the Red sea is Sofala. I do not think that it is too great a use of imagination to suppose that it would be from information received in what is now North Rhodesia that it was learnt that to the westward lay the sea again, and that this led to the attempt to reach it by the south. Once started from the neighbourhood of Sofala, they would find themselves in that great oceanic stream, the Agulhas current, which would carry them rapidly to the southern extremity of Africa. I, as a sailor, can also even conceive that, finding themselves in that strong current, they would be alarmed and attempt to turn back, and that after struggling in vain against it they would have accepted the inevitable and gone with it, and that without the Agulhas current no such complete voyage of circumnavigation would have been made. As Major Rennell in the last century pointed out, once past the Cape of Good Hope, the periodic winds, and over a great part of their journey the currents, would help them up the West African coast; and the general conditions of navigation are favourable the whole way to the Straits of Gibraltar, the ships keeping, as they would do, near the land; but we can well understand that, as recorded, the voyage occupied nearly three years, and that they halted from time to time to sow and reap crops. I should say that it is highly probable that either Simon's bay or Table bay was selected as one of these stopping-places.

No reference to this voyage has been found amongst the hieroglyphic records, and, indeed, so far few such records of Necho, whose reign was not for long, are known; but that it was regarded at the time as historical is evident, for Xerxes, a hundred years later, sent an expedition to repeat it in the contrary direction. This, however, failed, and the unfortunate leader, Sataspes, was impaled on his unsuccessful return. This attempt shows that the greater difficulty of the circumnavigation from west to east, as compared with that from east to west, was not realized, and points to the concealment of any details of the successful voyage.

Of Hanno's voyage from the Straits of Gibraltar to about Sierra Leone, the date of which is uncertain, but from 500 to 600 B.C., we should know little had not good fortune preserved the record deposited in a Carthaginian temple. But the well-known secrecy of the Phœnicians in all matters connected with their foreign trade and voyages would explain why so little was known of Necho's voyage, and our present knowledge of the extensive ancient gold workings of Rhodesia shows how much went on in those times of which we are wholly ignorant.

I have dwelt perhaps too long on this subject, but it has to me a great interest; and as it has not, so far as I know, been dealt with by a seaman who is personally well acquainted with the ways of seamen in sailing ships and with the navigation of the coasts in question, I hope I may be excused for putting my views on record. There are several references in Greek and Latin historians to other circumnavigations, but none of them can be trusted, and apart from Necho's voyage we hear nothing of the east and south coasts of Africa until the arrival of the Portuguese at the end of the fifteenth century. But they found a thriving civilization along the coast from Sofala northward, Shirazi, Arab, and Indian. Ruins exist in many places which have not yet been properly investigated, and we are quite unable to say from what date we are to place the earliest foreign settlements, nor how many breaks existed in the continuity of the gold-mining, which apparently was proceeding at or very shortly before the Portuguese visit.

After the recommencement of exploration by sea in the fifteenth century, seamen slowly gathered enough information to draw the lines of the coasts they passed along, and in time—that is, by the middle of the eighteenth century—most lands were shown with approximately their right shapes. But of true accuracy there was none, for the reason I have before mentioned, that there was no exact method of obtaining longitude. If we look at a general world chart of A.D. 1755—and to get the best of that period we must consult a French chart—we shall find on this small scale that the shape of the continents is fairly representative of the truth. But when we examine details we soon see how crude it all is. I have compared with their true positions the positions of thirty-one of what may be taken as the fundamental points in the world as given in the larger scaled French charts of 1755, from which the general one is drawn, and I find that on an average they are 48 miles in error. The errors vary from 160 miles to 2 miles. If the delineation of the coast-lines between be considered, the inaccuracies are very much greater.

Very shortly after this date more accurate determinations began to be made. The method of lunar distances was perfected and facilitated by tables published in the various astronomical "ephemerides," and seamen and explorers commenced to make use of it. Still the observation required constant practice, and the calculation, unless constantly made, was laborious, and it was used with complete success by the few. The great Captain Cook, who may be looked upon as the father of modern methods of surveying, did much to show the value of this method; but the chronometer came into use shortly after, and the principal advance in exact mapping was made by its aid, as I have already stated.

There is a vast amount yet to be done for Geography. Until we possess publications to which we can turn for full information on all geographical aspects of things on this globe of ours, there is work to be done. Seeing that our present publications are only now beginning to be worthy of being considered trustworthy for the very small amount of knowledge that we already possess, geographical work in all its branches is practically never-ending.

But of exploration pure and simple very little remains to be done. The charm of travelling through and describing an entirely new country which may be practically serviceable to civilized man has been taken from us by our predecessors, though limited regions still remain in Central Asia and South America of which we know little in detail.

I must except the Polar Regions, which are in a somewhat special category, as their opening-up affords few attractions to many people. But a knowledge of the past history of our globe—fit study for human thought—can only be gained

by study of the portions still under glacial conditions. What is there round the South Pole—a continent or a group of large islands? What is going on there? What thickness does ice obtain? Have these regions always been glaciated; and if not, why not? Can we get any nearer the mystery of magnetism and its constant changes by study at or near the magnetic poles? All these and many other scientific questions can only be solved by general geographical research in these regions, and all interested in such questions have been delighted at the recent attempts to gain more knowledge. The object of these expeditions was frankly and purely scientific. All hope of remunerative whale or seal fisheries had been dispelled by the visit of the Norwegian whalers in 1892 to the region south of Cape Horn, and the known general condition of the land forbade any expectation of other profitable industries, unless indeed gold and other valuable minerals should be found, which is always possible. Beyond the fact that exploring expeditions of this character keep alive the spirit of enterprise and bring out the finest characteristics of a race—which is a point by no means to be despised—no immediate practical benefit was to be expected.

Progress under the conditions must be slow, but I think that Great Britain may well be satisfied with the information collected in the Antarctic by Captain R. F. Scott and his gallant companions. The unfortunate detention of the *Discovery* by an unfavourable summer prevented the further coastal exploration which was part of the programme, but gave opportunity for further detailed examination of the inland conditions, which was carried out in defiance of the severest atmospheric and topographical difficulties, and with the greatest zeal and intelligence; and it may be doubted whether Science in the end has not gained more than she lost by the unexpected division of energy. The healthy conditions which prevailed throughout are a standing proof both of Captain Scott's eminent capacity as a leader and of the cheery spirit which animated the whole expedition. The full results of the scientific observations are not yet worked out, and in many cases for a complete appreciation of their bearing they must be compared and correlated with those of the other Antarctic expeditions, but many highly suggestive points have already been revealed. For the first time Antarctic continental land has been travelled over for long distances, and though the actual area of new discovery looks small on a map of the world, the distances covered can only be described as extraordinary, and far exceeding the most sanguine anticipations.

Few who considered the mountainous coast-line of Victoria Land and its complete glaciation, as reported by Sir James Ross from his distant view, thought that it would prove practicable not only to ascend those mountains, but to reach to heights much surpassing them behind. The reason that it proved feasible is that, while there are occasional heavy snowstorms, the annual snowfall is small, and the surface, therefore, is generally unencumbered with soft deep snow. And what did Captain Scott find after his memorable struggle up the glacier through the mountains? An enormous plateau at an elevation of about 9000 feet, nearly level, smooth, and featureless, over which he travelled directly inland for over 200 miles, seeing no sign at his furthest point of any termination or alteration in character. So far as could be seen from other journeys, glacial discharge from this great ice-sheet is very small, and practically it appears to be dead. Its accretion by fresh snowfall is insignificant, while on all sides along the flanks of the coastal mountains there are signs of diminution in the mass of ice.

The great ice-barrier east of Ross island tells the same tale. This magnificent feature presents to the sea a face of perpendicular ice-cliffs varying from 60 to 240 feet in height and 450 sea-miles long. Sir J. Ross mapped its position in 1841, and Captain Scott finds that it has retreated on an average 15 miles, varying

much in different parts. Should this rate of retreat continue the whole of this ice-mass, as far as Captain Scott saw it, will have vanished in 1000 years. As the motion of the ice-mass is also about 15 miles to the north in the same time, icebergs covering collectively an area of 450 miles by 30 have been discharged from it in sixty years. Captain Scott travelled over it nearly due south to a point 300 miles from its face, and then saw no sign of its end. It is bordered on its western side by a mountainous coast-line, rising in places to 15,000 feet. He found the ice practically flat and wholly unfissured, except at the side, where its northerly motion, found to be about 130 feet in the month, caused shearing and vast crevasses. All that is known of its eastern edge is that it is bordered, where it meets the sea, by land from 2000 to 3000 feet high, suspected by Ross and verified by Captain Scott. This may be an island, or more probably the eastern side of the great fjord or bay now filled by the barrier.

Captain Scott is of opinion that this great ice-sheet is afloat throughout, and I entirely agree with this conclusion. It is unexpected, but everything points to it. From soundings obtained along the face it undoubtedly has about 600 feet of water under it. It is difficult to believe that this enormous weight of ice, 450 miles by at least 360, and perhaps very much more, with no fall to help it along by gravity, can have behind it a sufficient force in true land glacier to overcome the stupendous friction and put it in motion if it be resting on the bottom. It is sufficiently astonishing that there is force enough even to overcome the cohesion at the side, which must be very great. The flat nature of the bottom of the Ross sea and the analogies of many geographical details in other parts of the world make it most probable that the water under the whole barrier is deep.

A point on which I have seen no comment is the difference in the appearance of the slopes of Mount Terror. Captain Scott found the bare land showing over large areas, but during the two summers of Ross's visit it was wholly snow-clad. Sir Joseph Hooker, the sole survivor of Ross's expedition, when questioned had no doubt on the subject, and produced many sketches in support. This may be due to temporary causes, but all the information collected by the expedition points without doubt to steadily diminishing glaciation in recent times. We have, therefore, this interesting fact, that both in Arctic and Antarctic regions, as indeed all over the world, ice conditions are simultaneously ameliorating, and theories of alternate northern and southern maximum glaciations seem so far disproved. But this does not mean that climatic conditions in the Antarctic are now less severe—probably the contrary. It has been pointed out by many that land glaciation may arise from varied primary causes, but one obvious necessity is that the snow-fall should exceed melting and evaporation. It need not be heavy; but if it is, it may produce glaciation under somewhat unexpected conditions. This would entail a vapour-laden air more or less continuously impinging upon the land at a temperature which will enable it when cooled, either by passing over chilled land or when raised to higher regions by the interposition of mountains, to give up its moisture freely. This condition is not fulfilled when the air as it arrives from the sea is already at a very low temperature.

It was my fortune to spend two long seasons in the Straits of Magellan, and I was daily more impressed by what I saw. There you have a mountainous ridge of no great height—very few peaks rising more than 4000 feet—opposed to the almost continuous westerly winds pouring in from the Pacific at a very moderate temperature and charged with much moisture. The result is that in the latitude of Yorkshire every mountain mass over 3000 feet high is covered with eternal snow, and sends glaciers down to the sea. I was convinced by what was going on under my eyes that it only required an upheaval of the land of 2000 feet or

so to cover the whole of Patagonia with ice. But then the climate would still not be very severe. The temperature of the wind from the sea would be the same, and such part of it as blew along the channels and on the lower land would moderate the cold caused by the ice-covered slopes. The shores of the whole of Western Southern Patagonia, deeply indented with long and deep fiords, indicate, according to all received views of the origin of such formations, that the land was formerly higher, while signs of glaciation are everywhere present.

The results of geographical research show us that in many parts of the world climate must have greatly changed in comparatively recent times. In the now arid regions of Northern Africa, Central North America, and in parts of Asia there is ample evidence that the climate was in times past more humid. In a remarkable paper on the causes of changes of climate, contributed by Mr. F. W. Harmer to the Geological Society in 1901, and which has not obtained the notice it deserves, it is pointed out how changes in the distribution of the prevalent winds would vastly alter climatic conditions. Like everything else in Nature, and especially in the department of meteorology, these questions are exceedingly complex, and similar results may be brought about in different ways, but there can be no doubt that the climate of South Africa would be greatly modified, and more rainfall would occur, if only the cyclonic storms which now chase each other to the eastward in the ocean south of the Cape of Good Hope could be prevailed upon to pursue a slightly more northerly line, and many obstacles to the agricultural prospects of South Africa now existing would be removed. This is, however, beyond the powers of man to effect; but, as I have just said, there are other ways of attaining the object, and it is earnestly to be hoped that the attention now being paid to afforestation may result in vigorous efforts to bring about by this means the improvement in humidity so much required in many parts of the country.

The other recent event in geographical exploration is the result of the expedition to Lhasa. It was an unexpected solution of this long-desired knowledge that it should come from political necessities and by means of a Government mission. The many ardent travellers who have dreamed of one day making their way in by stealth have thus been disappointed, but our knowledge is now fuller than could otherwise have been gathered. The most important fact is the revelation of the fertility of a large part of Southern Tibet. Much has been added to topographical knowledge, but the route-maps of the secret Indian native surveyors already had given us a rough knowledge of the country on the road to Lhasa. It was not, however, realized how great was the difference between the aridity of the vast regions of the north, known to us from the travels of men of various nationalities, and the better-watered area in the south, though from the great height of the plateau—some 12,000 feet—the climate is very severe. The upper course of the Brahmaputra has been traced by Captain Ryder, but, unfortunately, a political veto was placed on the project to solve the interesting problem of how this great river finds its way to the Indian plains, and this still remains for the future to unravel.

Of the ocean, which has been my own particular study for many years, and on which alone I feel any special qualification to speak, I have said but little, for the reason that when presiding over this section on a former occasion I took it for my theme, but there are a few points regarding it which I should like to bring to your notice.

It is of the ocean, more than of any other physical feature of our globe, that our knowledge has increased of late years. Forty years ago we were profoundly ignorant even of its depth, with the exception of a few lines of soundings then

recently taken for the first submarine telegraph cables, and consequently we knew nothing of its real vast bulk. As to the life in it, and the laws which govern the distribution of such life, we were similarly ignorant, as of many other details. The *Challenger* expedition changed all this, and gave an impetus to oceanographic research which has in the hands of all nations borne much fruit. Soundings have been obtained over all parts of the seas, even in the two polar seas; and though much remains to be done, we can now form a very close approximation to the amount of water on our earth, whilst the term "unfathomable ocean" has been shown to have been based on an entire misconception. Biological research has also revealed a whole world of living forms at all depths of whose existence nothing was known before.

In my former address, eleven years ago, I gave many details about the sea, of which I will only repeat one—which is a fact that every one should know—and that is, that the bulk of the ocean is about fourteen times as great as that of the dry land above water, and that if the whole of that land were thrown into the Atlantic ocean it would only fill one-third of it. Eleven years ago the greatest depth known was 4700 fathoms, or 28,000 feet. We have since found several places in the Pacific where the depth is nearly 5170 fathoms, or 31,000 feet, or somewhat higher than Mount Everest, which has been lately definitely shown to be the culminating point of the Himalayas. These very deep parts of the ocean are invariably near land, and are apparently in the shape of troughs, and are probably due to the original crumpling of the Earth's surface under slow contraction.

The enormous area of the sea has a great effect upon climate, but not so much in the direct way formerly believed. While a mass of warm or cold water off a coast must to some extent modify temperature, a greater direct cause is the winds, which, however, are in many parts the effect of the distribution of warm and cold water in the ocean perhaps thousands of miles away. Take the United Kingdom, notoriously warm and damp for its position in latitude. This is due mainly to the prevalence of westerly winds. These winds, again, are part of cyclonic systems principally engendered off the coasts of Eastern North America and Newfoundland, where hot and cold sea-currents, impinging on one another, give rise to great variations of temperature and movements of the atmosphere which start cyclonic systems travelling eastwards. The centre of the majority of these systems passes north of Great Britain. Hence the warm and damp parts of them strike the country with westerly winds, which have also pushed the warm water left by the dying-out current of the Gulf Stream off Newfoundland across the Atlantic, and raises the temperature of the sea off Britain. When the cyclonic systems pass south of England, as they occasionally do, cold north-east and north winds are the result, chilling the country despite the warm water surrounding the islands. It only requires a rearrangement of the direction of the main Atlantic currents wholly to change the climate of Western Europe. Such an arrangement would be effected by the submergence of the Isthmus of Panama and adjacent country, allowing the equatorial current to pass into the Pacific. The gale factory of the western Atlantic would then be greatly reduced.

The area south of the Cape of Good Hope is another birthplace of great cyclonic systems, the warm Agulhas current meeting colder water moving up from the Polar regions; but in the southern ocean the conditions of the distribution of land are different, and these systems sweep round and round the world, only catching and affecting the south part of Tasmania, New Zealand, and Patagonia.

In 1894 I spoke of the movements of the lower strata of water in the sea as a

subject on which we were only beginning to get a little light. Since that year we have learnt a little more. It is a common idea that at the bottom of the sea all is still; but this is a mistake, even for the deepest parts, for the tidal influence reaches to the bottom and keeps every particle in motion, though such motion is quiet and slow. Near the shore, however, though still in deep water, the movement may be considerably increased. Cases have occurred in late years when submarine cables have broken several hundred fathoms deep, and when picked up for repair it has been found that the iron wire covering has been literally rubbed away as by a file. This can only be the result of an undercurrent along the bottom moving the cable to and fro. Such a current might be caused by a submarine spring, for there is no doubt that much fresh water finds its way into the ocean in this fashion, but it is more probably generally an effect of acceleration of the tidal movement due to the rising slope of the continent. In connection with this, further facts have come to light in the course of recent marine surveys. Many isolated shoal spots in the great oceans have figured in our charts, the results of reports by passing ships who have said they have seen breakers in fine weather. Such places are the terror of seamen, and it is part of the duty of surveying ships to verify or disprove them. Very much has been done in the last eighteen years, with the result that the majority of them have, as dangers, disappeared. In many cases, however, a bank has been found, deep in the ordinary acceptation of the word, but much less deep than the surrounding sea—solitary ridges, in fact, rising from the ocean floor. Frequently, in examining these banks in search of shoaler spots, breakers have been reported and recognized as such on board the surveying ship from a distance, but on approach they have proved to be small overcurls caused by tide ripplings, and the depth of water has proved to be several hundred fathoms. These ripplings are clearly caused by the small tidal motion in the deep water, generally in these cases of over 2,000 fathoms, meeting the slope of the submerged mountain range, being concentrated and accelerated until the water finally flows up the top of the slope as a definite current, and taking the line of least resistance, that to the surface, makes itself visible in the shape which we are accustomed to associate with comparatively shallow water. These cases form remarkable instances of the manner in which extensive motion of water may arise from very small beginnings.

An observation I was anxious to make in 1894 has been successfully carried out since. This was to ascertain whether there was any permanent undercurrent in the Straits of Bab-el-Mandeb due to more water being forced through the strait on the surface by the persistent south-east wind of winter than could be evaporated in the closed Red sea. Such return undercurrents have under somewhat similar circumstances been shown to exist in the Dardanelles, Strait of Gibraltar, and in the Suez Canal. The observation at Bab-el-Mandeb was difficult. The wind is strong and the disturbance of the sea is considerable, while the water is 120 fathoms or 700 feet deep. But a surveying vessel maintained herself at anchor there during four days, and, by the aid of an ingenious apparatus sent from England for the purpose, clearly proved the existence of a current of 1½ knot flowing steadily at depths below 70 fathoms out of the Red sea, whilst in the upper strata there was a similar current flowing in. In such ways is interchange of water provided for by nature in places where tidal action does not suffice.

In what I fear is a very discursive address I have not mentioned the interior of Africa. In the first place, it is a subject of itself; and as we shall have, I hope, many papers on African subjects I have thought it better to deal mainly with generalities. Still, I cannot refrain from a few words to express the astonishment I always feel when I hear people complain that Africa goes slow. When I look at

what has been effected in my own lifetime, it appears to me that, on the contrary, it has been rushed. The maps I learnt from as a boy showed the whole interior as a blank. There are now no parts that are not more or less known. The great lakes have all been revealed; the great rivers have all been traced; Europeans are now firmly fixed with decent governments in parts formerly a prey to tribal wars and the atrocities of the inland slave traffic. Railways are running over regions unknown forty years ago, and one of the most astonishing things to me is that I should be able to hope now to visit in comfort and luxury the Great Victoria Falls which my old friend Sir John Kirk—whom I left the other day hale and hearty—was, with the exception of Livingstone, the first white man to see, after a long and laborious journey in his company in 1860.

I could not help being amused as well as interested at seeing a short time ago a proclamation by the Government of Northern Rhodesia, dated not far from Lake Bangweolo, calling on all concerned to observe neutrality during the present war between Russia and Japan. I think that if anyone had prophesied to Livingstone, as he lay in 1873 lonely and dying by the shores of that newly discovered lake, that such an edict would be issued in thirty years he would have expressed a doubt as to its fulfilment.

To Southern Africa nature has denied two of the features that facilitate rapid progress—good harbours and sufficient rainfall—but the energy of man has done wonders to provide the former where possible, and will doubtless do more; whilst I believe that the lack of the latter will also be overcome in the same way. The co-ordinated—or, in other words, the scientific—observations made in many other countries have pointed out a possible solution. On the other hand, the height of the inland plateaux makes it possible for the white man to live and work in latitudes which would under other conditions be tropical. South Africa must have a great future before it; and while some present circumstances may delay development of its natural advantages, I am inclined to think that in the long run prosperity may be more solid and material for being made in the face of difficulties, as has so often occurred in the history of the world.

REVIEWS.

EUROPE.

Neolithic Man in England.

'Neolithic Dew Ponds and Cattleways.' By Arthur John Hubbard, M.D., and George Hubbard, F.S.A., F.R.I.B.A. London: Longmans. 1905. Large 8vo. Pp. 71. *Illustrations. Price 3s. 6d. net.*

The authors give a detailed description of the various prehistoric earthworks and other remains to be seen on the Downs of Sussex and Dorsetshire, especially those associated with the well-known Chanctonbury and Cissbury rings near Worthing, and Maiden Castle near Dorchester. They make the attempt to correlate the various remains, and to explain the uses or objects of the different features; and though, in so doing, they must necessarily fall back in many cases on hypothesis, they piece together such evidence as exists in a way which is certainly plausible, and helps us to realize the probable mode of life of the old inhabitants of these places of refuge of the remote past. After pointing out the difficulty entailed by water-

supply on these upland regions, they suggest that these could only have been got over by the use of "dew-ponds" such as still exist on the downs, the traces of earthworks in their vicinity fully bearing out the idea that some of these date from neolithic times, and were included in the general scheme of fortification, which provided for the safe passage of cattle to and from these drinking-places. The authors also adduce evidence to show that some of the old cattle-tracks visible on the Downs date from the same period, being in clear relation with the other neolithic remains. The book is excellently illustrated by photographs, but the want of plans showing the mutual relations of the features described may be felt as a drawback by those not familiar with the localities.

AFRICA.

Barotseland.

'In Remotest Barotseland.' By Colonel C. Harding, C.M.G. London: Hurst & Blackett. 1905. Pp. xvi. + 414. *Map and Illustrations. Price* 10*s.* 6*d. net.*

In a volume of some 400 pages, Colonel Harding, Commandant of the Barotse Native Police, gives a readable account of travels undertaken in the course of duties which led him through some of the less-known parts of Lewanika's "empire." The record of distances travelled over, giving as it does a monthly average of 350 miles, inclusive of rests, is one of which the author may justly be proud, especially when it is considered that the time occupied included the whole of one and the greater part of a second rainy season.

The book is subdivided into four parts. Part i. describes a journey up the Zambezi; a short sojourn at Kakengi's, at that time the home of one of the most disreputable debauchées in Africa, and the site of a Portuguese fort; a visit to the Zambezi source, of which a terse and accurate description is given; and thence overland to Nyakatoro, under circumstances calling for the best qualities of the British explorer. Part ii. traces the journey from Nyakatoro westwards to Chisamba, along the route followed by Livingstone, Cameron, Arnot, Quicke, and others, and thence back to Lialui over the southern trade route. Part iii. takes us down the Zambezi to the Victoria falls, and thence to the Kafue-Zambezi confluence, and back to Lialui. Part iv. describes a visit to the source of the Kabompo, which was discovered, located, and fixed by the Belgian explorer Lemaire in the year previous. The book terminates with a short description of Lewanika's visit to England on the occasion of King Edward's coronation.

The book is written in a light vein, and is never dull reading. Its interest is enhanced by the fact that a fair proportion falls in districts hitherto visited only by one or two previous explorers. Perhaps Colonel Harding is somewhat too prone to "discover" points of interest already discovered, fixed, and described. For instance, we read of the "discovery of the source of the Zambezi;" of "the source of the Kabompo, which up to that time had not been located;" and "though some of Major Gibbons' parties explored a portion of the Kafue, I know of no white man who has previously viewed this scene" (the Balungwe rapids). A glance at authentic maps compiled by this Society, the Military Intelligence Division, or the British South African Company, from work achieved by different explorers prior to the author's experience would doubtless have led to modifications in the text here and elsewhere. At the close of Part i. Colonel Harding remarks, "Our observations, especially for latitude, have been most carefully made and repeatedly checked." The results might with advantage have been given in the book, while the addition of a more adequate map would have been useful as a guide to future travellers, to

whom it is often a great convenience to know the exact position of places *en route*. The book is, however, an interesting record of travel, in which the author shows zeal, energy, and resource of a high order.

Colonel Harding is at his best in his descriptions of contact with local natives. The occasional glimpses we are given of native customs and character convey a correct impression, and make us wish that the author had enlarged further on the subject, for although the tribes visited have been previously discussed, much has yet to be learned of this interesting Bantu group. Many years will not of necessity elapse before it will be impossible to produce a photograph so typical and grotesque as that facing p. 348; so too with tribal customs. The vandalizing energy of the British settler rapidly obliterates native distinctions and idiosyncrasies.

On p. 118 the author gives quite a new version of the origin of the Barotse and Valovale, which he claims to be "according to the most reliable testimony procurable." To claim credence for a version so entirely at variance with previous research by such authorities as the late Mons. Coillard and others of widespread experience, some argument or reason should be forthcoming. The claim of Nyakatoro to blood relationship with Lewanika does not supply proof positive that their respective tribes are related. African relationships, even "blood relationships," are proverbially vague. Be this as it may, in the face of more logical theories, it is impossible to conceive that the Barotse and Valovale spring from the same stock. In type, language, customs, religion, and character the two tribes have nothing in common. Then we are told that "whilst Nyakatoro was building up the constitution of the Valovale country, Murambo and his son Litia . . . were living in the Barotse country," etc. Murambo died over three-quarters of a century ago, Litia (Lewanika's father) being a small boy at the time. Although Nyakatoro, for an African, is a very old woman, she was probably yet unborn, much less was she making history, at the time referred to.

Colonel Harding does good service in once more emphasizing the appalling extent to which the slave-trade is exploited for the benefit of the Portuguese colonies. As far as Bihe he bears out the late Major Quicke's evidence in detail, though the latter officer was able to trace it onwards to the port of Benguella. Here are some extracts: "John tells me that at a kraal on the Kabompo he saw slaves with yokes and shackles lying prostrate outside their huts. . . . We found lots of stakes and yoke-sticks forked and bored, through which a stick or chain is inserted to keep them on their victim's neck." "Every day I see signs of the slave-trade, the trees literally hung with the shackles which are used to put the hands of the slaves in at night. . . . These are left behind, often on the corpse of its unfortunate prisoner." "The wayside trees are simply hung with disused shackles . . .; skulls and bones bleached by the sun lie where the victims fell, and gape with helpless grin on those who pass, a damning evidence of a horrible traffic." "Other remains are found; here the skull is battered in by the trader's axe, and the body clearly exhibits signs of the greatest torture and pain in the throes of death."

A. St. H. Gibbons.

AMERICA.

The Bahama Islands.

'The Bahama Islands.' Edited by G. B. Shattuck, ph.d., Associate Professor of Physiographic Geology in the Johns Hopkins University, Baltimore. New York: The Macmillan Company. 1905.

This is a monograph containing the results of the labours of a scientific expedition composed of twenty-five members sent out by the Geographical Society of

Baltimore on June 1, 1903. The expedition had only five weeks on the islands for actual work, but during that time "visited Abaco, New Providence, Andros, Green Cay, and the Eleuthera group of islands, Cat island, Rum Cay, and Watlings island," and different members of it made minute investigations with regard to the geology, tides, terrestrial magnetism and climatology, soils, botany, mosquitoes, fishes, batrachians, reptiles, mammals and birds, the sanitary conditions of the islands, and the pathological condition of its inhabitants. On all these subjects detailed reports are given, copiously illustrated by photographs, coloured plates, diagrams, and maps. A history is added extending over 168 pages, and that is followed by a concluding chapter by the editor, containing some general considerations with regard to the economic and social condition of the people. Obviously the work will be of value chiefly to specialists, but it may be of more general interest to mention the conclusion arrived at by the geologists of the expedition with regard to the topographic history of the islands. Dr. Northrop, in 1890, had found evidence of recent elevation in the islands, while Prof. Alex. Agassiz, in 1893, considered that subsidence satisfactorily explained their present configuration. The geologists of the present expedition believe that there was a period when the islands stood at least 300 feet higher than they do at the present time, and that then the limestone rock of which they are composed was dissolved into caverns and grottoes, that a period of depression followed, during which the land sank at least 15 feet lower than the level now occupied, giving opportunity for the formation of the deposits bearing marine shells and the coral reef on Green Cay, and for the cutting of the ancient sea-cliffs, and that this was followed by a rise to the present level. To determine whether this level is now in process of change, and in what direction, bench-marks, which are fully described in the volume, have been erected at Nassau. G. G. C.

Great American Explorers.

'History of the Expedition under the Command of Captains Lewis and Clark.' With an Account of the Louisiana Purchase by Prof. John Bach McMaster. *With Illustrations and Maps.* 3 vols. *Price* 10*s.* 6*d. net.*

'Narratives of the Career of Hernando de Soto in the Conquest of Florida.' Edited with an Introduction by Edward Gaylord Bourne. Illustrated. 2 vols. Sm. 8vo. London: D. Nutt. 1905. *Price* 7*s.* 6*d. net.*

These form the first volumes of a series of reprints of narratives of American travel published originally in the United States, and re-issued in this country by Mr. Nutt, under the title 'Great American Explorers.' They are intended rather for the general public than for students, and the moderate price and handy form in which they are presented render them very suitable for this purpose. The popularizing of standard works like the Lewis and Clarke narrative is a distinct service to geographical history, for it is to be feared that the doings of many of the great travellers of the early modern period which aroused the emulation and spurred the energies of their successors in the middle of the nineteenth century, have become far less familiar to the present generation than they deserve to be. Such a series has long been a desideratum, for while the original works may be accessible to students in geographical libraries, their increasing rarity, and to some extent, also, their ponderous size, have put them out of the reach of the ordinary reader. The enterprise might well be extended in course of time, so as to embrace other parts of the world, the American field having within the past few years been worked with considerable energy on the other side of the Atlantic, whereas, apart from isolated reprints and a few of the volumes of the "Minerva Library," the modern

pioneer travellers in Asia, Africa, and Australia have received comparatively little attention.

Of the two famous expeditions dealt with in the present volumes, that of Lewis and Clarke, after being neglected for nearly a century, has given rise to what might almost be called an epidemic of publishing activity within the past few years. A certain amount of the energy thus put forward may no doubt be regarded as wasted, so many independent enterprises having been devoted to one and the same object. The present reprint has, however, the advantage in the lightness and handy form of the volumes, a point of no little importance, in view of the demands upon space made by the flood of modern geographical literature. Like Prof. Hosmer's edition of 1902 (*Journal*, vol. 21, p. 573), it reproduces the narrative prepared by Biddle and published in 1814. Whatever disadvantages this may have had as a compilation, as compared with the actual records kept by the explorers (which of course formed its basis), there is no doubt that it is the most suitable for general use, by reason of its relative conciseness and connected nature. Reduced facsimiles of the original maps and portraits are also given, and there is a brief introduction on the Louisiana purchase by Prof. J. B. McMaster, while explanatory notes on the several sections of the route are prefixed to each volume.

The other two volumes are in some ways of greater original value, for in spite of the many writers on American history who have touched upon De Soto's romantic adventure, no very accessible collection of first-hand authorities was previously in existence. The volumes are edited in a scholarly way by Prof. E. G. Bourne, who gives a clear introductory sketch of the literary material available. The collection of documents is the most complete yet issued in English, and includes the first English version ever given of Oviedo's account, based on the diary of Rodrigo Ranjel, De Soto's private secretary, which had not become generally known at the time the Hakluyt Society's edition of De Soto was issued (1851). While this reproduced Hakluyt's translation of the narrative by the "Gentleman of Elvas," the present edition follows the version of Buckingham Smith, the nineteenth-century English of the latter being thought more suitable for present-day readers. The same writer's version of Biedma's relation is also utilized. Altogether the volumes form a useful addition to the literature of the subject, the only cause for regret being, perhaps, that doubtful questions in regard to the route followed are not more fully discussed by the editor.

ANTHROPOGEOGRAPHY AND HISTORICAL GEOGRAPHY.

A Classical Atlas.

'Murray's Small Classical Atlas.' Edited by G. B. Grundy, M.A., D.LITT. London: Murray. 1904. *Price* 6*s*.

It is clear that in the immediate future classical teaching will occupy itself with the subject-matter of the Greek and Latin authors even more than with their language. For such study 'Murray's Small Classical Atlas' affords considerable assistance, as much indeed as its size, cost, and purpose would fairly permit. The separate maps have already been noticed, as they appeared, in previous numbers of the *Journal*; it only remains, therefore, to deal with the Atlas as a whole. Its clearness is a great merit. Coloured contours indicate the natural features of the country; the lines which usually mark the boundaries of provinces are absent, so that the names of places and the main roads stand out with distinctness. The absence of the boundary-lines has, moreover, this advantage: the boundaries are often conjectural and varied from time to time, and the attempt to give them precisely once and for all was misleading to beginners. The only suggestion we have

to make on this head is that an extra contour should be introduced into the map of Asia Minor. For the other maps it does not matter seriously, if it matters at all, but so much of Asia Minor lies between 3000 and 9000 feet above the sea that, by the absence of indications of height between these altitudes, the effect of the physical features of the country on its history is somewhat obscured. The addition of one, or at the most two, of the contours given in the corresponding Handy-map would completely meet the case. The editor is, we believe, justified in claiming for the Atlas that it contains all the names necessary for ordinary classical study, and as a rule—if not always, probably in all important cases—sites not fixed with certainty are indicated. It also contains, we believe, the maps generally necessary for that purpose; and here maps ix., xi., and xiii., which contain small maps of Rome, Athens, and other places, chiefly battlefields, are a great gain. It is a pity that the name of each map is not given on the blank page which precedes it, but any one can insert the name for himself, and no one who has used the maps for teaching schoolboys or undergraduates will fail to appreciate their value.

H. C.

GENERAL.

More Columbus Literature.

'Etudes critiques sur la vie de Colomb avant ses découvertes.' Par Henry Vignaud. Paris. 1905.

'Nuevos Autografos de Cristobal Colon y Relaciones de Ultramar; los publica La Duquesa de Berwick y de Alba.' Madrid. 1902.

In the first-quoted work M. Vignaud continues his Columbian researches with a series of six studies, devoted respectively to the family and descent of the discoverer, the two piratical "Colombos" (Guillaume de Casenove and Georges de Bissipat), the date of the birth of Christopher, his education and earliest voyages, and his settlement and marriage in Portugal. The author, as he has shown in previous works, considers that the tradition of the explorer's early life, as given us in Christopher's own letters, in the 'Historie' of Ferdinand Columbus, and in the 'Historia' of Las Casas, is on the whole fabulous and fabricated, with a view to suggesting an illustrious origin and youth for one who was essentially a man of the people. M. Vignaud disclaims the presentation in this volume of new material ("ceux qui ouvriraient ce livre y chercher des documents inconnus ou des faits que perconne n'a mentionnés, peuvent donc le refermer"); what he does claim is a fresh presentation of the subject, according to the light hitherto obtained ("des faits qu'ils croyaient bien connaître se présenteront à eux sous un aspect tout autre que celui sous lequel ils les voyaient; d'autres auxquels ils n'avaient attaché qu'une importance secondaire prendront une signification particulière, et des assertions qu'ils s'étaient habitués à tenir pour certaines leur apparaîtront, les unes comme douteuses, les autres comme nettement controuvées"). M. Vignaud has made a very careful, detailed, and suggestive examination of Columbus's early life, in which a certain element of untrustworthy tradition has been recognized by the most competent students at least since the publication of Harrisse's 'Fernand Colomb.' His main conclusions are the following: (1) Christopher Columbus did not belong to a family of navigators, as he himself assures us ("comme il l'assure"), nor to a noble house, as his son declares ("comme le dit son fils"); his parents and all his near relatives, like himself, were weavers. (2) There were never any "admirals" in Christopher's family, as he alleged, and as Las Casas and his son Ferdinand maintained after him. The two "Colombos" with which the Columbian tradition associated his family were of totally different origin, the one a Frenchman,

the other a Greek, who became a French citizen. (3) Christopher himself was born in 1451, not in 1435 or 1436, nor in 1446 or 1447, as commonly supposed. (4) Christopher was never at any university, neither at Pavia, where Las Casas and Ferdinand assure us he was sent to study, nor any other. On the contrary, he received the ordinary education of an artisan's child. (5) He did not, at the age of fourteen, as he tells us, give up other professions or prospects for a life absolutely devoted to seafaring; at twenty-two he was still following the trade of a weaver at Savona, near Genoa (apparently after a certain interval of maritime experience), and even after this he appears to have joined with his father in keeping a tavern. (6) He did not go to Portugal in 1470, as one might infer from some of his statements, but in 1476. (7) He did not sail to Iceland "and beyond," at any time, as he declares. All details given of this furthest north are obviously invented. (8) He only settled in Portugal in 1477, being then some twenty-six (or at the most twenty-seven) years old; he was not then a mariner of any great experience, and there is no sufficient reason to believe that he had then turned his attention to scientific geography or trans-Atlantic enterprise. (9) He never fought for King Réné; at the time when, as he says, he commanded a warship in the service of that sovereign, he was only twenty-one, and was still following his weaver's craft.

On the other hand, it is maintained in these 'Etudes' that Columbus may be credited with a true suggestion in so far as the making of some Mediterranean voyages from the age of fourteen, or thereabouts, is concerned; it is not disputed that he then developed a great taste for a maritime life; but it is contended that in 1470, when about nineteen, he was engaged in trade at Genoa, that in 1472 he was certainly pursuing a weaver's life in that city, and that in 1473 he is with equal certainty to be fixed in Savona, where also, in all probability, he was engaged in his weaving business. From this time, all trace of him is lost in Italy, and his name disappears from the notarial records of Genoa and Savona; but it is suggested that in 1474–5 he went to Chios with some Genoese ships, two of which were commanded by Genoese captains (di Negro and Spinola), who are indubitably to be found associated with him in later time. In Chios he probably stayed some time, M. Vignaud allows, for his observations on the mastic trade of the island argue a pretty detailed knowledge.

Once more, Christopher Columbus was unquestionably present at the naval battle of August 13, 1376, when Guillaume de Casenove, surnamed "Coullon" (one of the two piratical "Colombos" above referred to), in command of a mixed Franco-Portuguese fleet, attacked near Cape St. Vincent four Genoese vesels, two of which were the ships of di Negro and Spinola. The latter, escaping from the fray, brought Columbus to Lisbon, and after a stay of some months in this port, left it for England in December, 1476. With them again, it is allowed, Christopher probably went. Both Bristol and Galway are here reckoned among the places genuinely visited by the explorer, following indications given us by himself; and it is considered probable that this assertion of having been in "the North" in February, 1477, is so far true that at this time he made a voyage among the islands lying off Britain.

Those of us who have previously found themselves unable to agree with certain conclusions of M. Vignaud in his 'Lettre et Carte de Toscanelli sur la route des Indes par l'Ouest,' may fairly recognize in this volume a body of carefully sifted historical fact, presented with great clearness, and on a great number of points at least appealing strongly to one's judgment as adequate and correctly viewed. It is obvious, at the same time, that many of the inferences drawn will be considered by some to be of a highly controversial character; and those who have studied the question know that such points as the 1451 birth-year (even though

appearing to have excellent support from the best evidence) are not likely to be accepted by "conservatives" without such complete demonstration as to put the matter out of the reach of argument.

The interesting publication of the Duchess of Berwick and Alva contains, among other specimens of Columbus's writing, a sketch of part of the coast of Hispaniola, drawn by him in 1492; it also gives the text of various autograph letters of the Admiral to his son D. Diego and to Fr. Gaspar Gorricio; a list of the companions of the discoverer on the first voyage; a list of various (seventy-eight) important documents relating mainly to the Spanish possessions in America, with copious extracts from some of these; forty-three "Relaciones de Ultramar" (*textos y extractos*) bearing principally upon the East Indies; and similar selections especially concerned with Yucatan and the Philippines. There is much that will be found useful to historical students in these collections, but they appear rather a heterogeneous and bewildering mass as they are presented to the reader. The phototype reproductions are very good and clear (specimens of Columbus's writing and his sketch of Hispaniola, facing pp. 5 and 7; and a sheet of the 1568 atlas of Vaz Dourado, preceding p. 125).

C. R. B.

THE MONTHLY RECORD.

EUROPE.

The Earthquake in Italy.—At about five minutes to three o'clock on the morning of September 8 a destructive earthquake occurred in the province of Calabria. The centre of maximum violence, according to the Central Meteorological Bureau, as reported in the *Times*, was in the neighbourhood of Monteleone, the shock seems to have caused damage to buildings at a distance of 25 miles, and the most distant place where it is reported to have been felt was Bari, about 175 miles from Monteleone. From this it will be seen that the earthquake covered ground which was made classic in seismology by the great earthquake of February 5, 1783, and many of the places destroyed or damaged by the late earthquake had also suffered from the earlier one. The point of greatest violence was not, however, quite the same, for in 1783 it was placed by Sir William Hamilton near Oppido, about 26 miles south-south-west of Monteleone. The earthquake is best known in this country through the account of it contained in Sir Charles Lyell's 'Principles of Geology,' by it great landslips were caused, fissures opened in the earth, vents were formed from which sand and water spouted forth, and changes of surface-level produced. For a long time it was the standard instance, quoted in all text-books, of these greater manifestations of earthquake energy, and only within the last quarter of a century, principally within the last few years, have the older instances been superseded by later ones, studied in the light of a century's advance of knowledge. It does not seem, to judge from the reports which have reached this country, that the recent earthquake was by any means so great as that of 1783; this was distinctly felt at Naples, 200 miles from Oppido, and is said to have been noticed at Rome, a distance of 310 miles, the region of damage extended to 75, and that of destruction to 25, miles from Oppido. A comparison of these distances with those given in the case of the recent earthquake, will give some idea of the relative magnitudes of the two shocks, and in the matter of destruction of human life the disparity is

even greater, for the 4000 deaths which have been due to the last earthquake are few beside the 40,000 at which Sir William Hamilton estimated the death-roll in 1783. Yet of this very earthquake, Sir Charles Lyell wrote that neither "in violence, nor in the extent of country moved, was this convulsion remarkable, when contrasted with many experienced in other countries, both during the last and present century; nor were the alterations which it occasioned in the relative level of hill and valley, land and sea, so great as those effected by some subterranean movements in South America."* The comparative magnitude of the earthquake is indicated by this sentence, and also shown by the fact that the amplitude of the record on Prof. Milne's seismograph at Shide was the same, viz. 11 millimetres, as in the case of the Indian earthquake of April 14 last, though the origin was four times further off in this case than in the other.

Iceland.—A Consular Report (Ann. Series, 3350) gives the population of Iceland, on December 31, 1904, at rather more than 79,000, and of Reykjavik at 8000. Seven hundred and fifty persons emigrated from Iceland in 1903 and 1904. In January, 1905, earthquakes, not destructive, were felt at Reykjavik and the south of Iceland. Imports and exports in 1901 and 1902 show an increase on preceding years. Next to Denmark, the United Kingdom enjoys much the largest share of the traffic. Salt fish is more than ever the most important article of export. Spinning and weaving factories having been recently established, the export of wool to Norway is reduced to insignificance. Barter is rapidly becoming obsolete. In June, 1904, a bank was opened, issuing notes payable on demand. The Great Northern Telegraph Company at Copenhagen was in the spring of this year to begin laying a cable from the Shetland islands to Iceland. The tonnage entering Icelandic ports in 1902 (which reached a total of 84,609) shows an increase, especially in steam shipping. A new lighthouse has been erected near Seydisfjord, which, with its good harbour and first-class accommodation for loading and unloading, has become a staple place for a great part of the island, and a coaling-station for liners and fishing-vessels.

ASIA.

Messrs. Barrett and Huntington in Central Asia.—Writing from Khotan on July 21 last, Prof. Ellsworth Huntington sent us some account of the progress of this expedition down to that date. Before leaving Leh, Mr. Huntington had made an excursion to the Pang-kong lake (14,000 feet), on the borders of Tibet, and he gives an interpretation of the lake's history which differs from that of former travellers. In his view it occupies a long narrow rock-basin, produced by the erosive action of the glacier—some 200 miles long—which once occupied the valley. Since the formation of the basin the level of the lake has fluctuated two or three times during later, less severe, glacial epochs. The route followed across the Himalaya was that by the Karakoram pass, a start being made a month before the usual opening of the road. The weather was fortunately good, and no serious difficulties were encountered, but the badness of the road exceeded all anticipations. In Chinese Turkestan, the authorities had proved helpful in every way, and some good scientific work was being done. The moraines and terraces in the mountain valleys confirmed the hypotheses formed further west. The travellers were able to observe the deposition of loess daily before their eyes. It was hoped to devote the autumn to the southern border of the Tarim basin, and the winter to Lop Nor, the idea of a visit to Tsaidam having been abandoned for the present.

* 'Principles of Geology,' chap. xxix., 11th ed., p. 113.

Mr. Hosie's Journey in Western China.—A report by Mr. Hosie on a journey undertaken by him last year from Chengtu to the Tibetan frontier has been issued as a Parliamentary Paper (China, No. 1, 1905). The outward journey was made over well-known routes; the first part, as far as Ta-chien-lu, following the southern road *viâ* Mount Omi and the valley of the Tatu-ho or Tung river, which has been described (among others) by Mr. Little in his book, "Mount Omi and Beyond." Mr. Hosie, however, supplies a wealth of details on the country traversed and its people, which make his report a useful supplement to previous accounts. Among the points to which he gives special attention are the trade and trade routes, industries and manner of life of the people, the extent and nature of cultivation, and other subjects. He also records frequently the altitudes along the route, though, as he merely refers to these as taken with the "hypsometer," it is not quite clear what amount of dependence is to be placed on them. The height of Mount Omi he found to be 10,158 feet, as compared with Baber's estimate of 11,100 feet. As regards the Tung valley, he expresses his astonishment that any trade can exist by such a route, and the fact that it does shows, he says, the spirit of enterprise which makes the Chinese the born trader that he is. As a trade route to Tibet, the northern route from Ta-chien-lu onwards * is said to be much more used than the better known official route *viâ* Batang, which he himself followed. It passes through the native state of Derge (noted for its copper work), west of the upper Yalung. While at Ta-chien-lu Mr. Hosie made careful inquiries as to the Tibetan trade, and he puts the quantity of the brick tea which goes west from that frontier post as 11,377,333 lbs. The principal import into Ta-chien-lu from Tibet is musk, while the import of wool seems to be less than has been supposed. A small amount of cotton cloth is received from Burma, through Yunnan. Between Litang and Batang brigandage seems to have driven trade from the official route, and it follows instead a small road *viâ* Mai-ya-ku. From Batang Mr. Hosie paid a visit to the Tibetan frontier, some excitement being thereby caused among the Tibetan authorities, who assembled the guard to oppose his further advance. The news of the British entry into Lhasa and the flight of the Dalai Lama reached the Chinese commissary who accompanied him the day after leaving Batang. Near Batang some attempt has lately been made by the Chinese to bring the waste land into cultivation, but elsewhere the extent of land under crops is exceedingly small. In the country of mountain and forest between Ta-chien-lu and the frontier, the limit of cultivation is under 13,000 feet. The trees mentioned most frequently are the prickly oak and the silver fir, the former apparently preferring the southern, the latter the northern slopes. The return from Ta-chien-lu to Chengtu was made by a more northerly route than the usual one, through a country that has been little visited by Europeans.† It led north across the Ta-pao-Shan (14,490 feet) to Romi Chango, in the valley of the Ta-chin-ho (Great Gold river), as the upper course of the Tung is here called. The road was bad and involved many difficulties, a considerable amount of snow having already fallen. Mr. Hosie came in contact with some of the aboriginal tribes inhabiting this region, who speak one language with slight variations. For writing it they employ the Tibetan characters (omitting the superfluous letters), but they do not understand Tibetan. From the valley of the little Gold river the route (here a trade highway) strikes across to Kuan Hsien on the Min above Chengtu.

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* This is the route traversed in its eastern section by A-K, and further west by MM. de Rhins and Grenard.

† It had been previously traversed by the Russian Potanin and the Austrian Rosthorn (cf. *Journal*, vol. 15, p. 277).

The Russo-Japanese Treaty.—By the treaty of peace signed at Portsmouth, N.H., on September 5, Japan once more receives an accession to the area of her territories. In the case of Korea she assumes a virtual protectorate, Article 2 of the treaty stating that Russia recognizes the preponderant interest, from political, military, and economic points of view, of Japan in the Empire of Korea. While Manchuria is to be evacuated by both powers, the Russian rights possessed through the lease of Port Arthur and Dalni, with adjacent territory, pass over entirely to Japan. Russia also cedes to Japan the southern part of Sakhalin island, as far north as the 50th degree of north latitude. The areas represented by these three territories are approximately as follows: Korea, 85,000 square miles; Port Arthur, etc., 1000 square miles; Southern Sakhalin, 12,000 square miles. With these additions the total territory possessed by or under the influence of Japan now amounts to about 260,000 square miles. In addition to the above, Japan takes over the Russian rights in respect of the southern section of the Manchurian railway, with the mines in its vicinity. The railway is to be worked by the two powers jointly, a junction between the two sections being effected at Kwang-cheng-tse, and through commercial traffic is to be encouraged, while the use of the line is restricted to commercial and industrial purposes.

Origin of the Name Celebes.—To the explanations lately suggested by various writers as to the origin of the name Celebes, another has been added in the fifth number of *Petermanns Mitteilungen* for the present year by Baron von Hœvell, formerly governor of the island. He points out that the name is not in use among the inhabitants (who speak instead of Tanah Mangkasara, or Tanah Bugise), so that it must have been originated by foreign visitors. The explanation current in Macassar is that on the first arrival of Europeans the name of the island was asked for; but, as so often happens in similar cases, the tenour of the inquiry was misunderstood, it being thought that it related to the kris always carried in the girdle. The answer was, therefore, "Sóle besi" ("an iron kris"). In accordance with this, it is stated that the current accentuation on the second syllable is of modern origin, the accent having been formerly placed on the first. Of previous explanations, that of Dr. F. Sarasin derived the name from the mountain range Kalabat, but it was pointed out in opposition to this that the *c* in Spanish and Portuguese is always soft before *e*.

AFRICA.

Mr. R. MacIver on the Rhodesian Ruins.—In view of the meeting of the British Association this year in South Africa, Mr. R. MacIver went out to Rhodesia in April last under the auspices of the Association and of the Rhodes trustees for the purpose of examining the ancient ruins of that country, the intention being that, on the visit of the Association to Bulawayo, the results of his investigations might be put before the meeting. This was done in a lecture delivered on September 9, in which Mr. MacIver surprised his audience by putting forward conclusions which, if accepted, must revolutionize *in toto* our ideas as to the history of the ruins. He has examined a number of the more important ruins, including those of Zimbabwe, Inyanga, Niekerk's farm, Dhlo-Dhlo, and Insiza, and has reached the conclusion that none of the ruins are older than the fifteenth or sixteenth century, but that they were the work of native Africans under the dynasty generally known as Monomotapa. From the brief summaries of the lecture which have yet reached this country by means of the telegraph, it is, of course, impossible to express any opinion as to the validity of the arguments by which this surprising conclusion has been reached. Many of the statements quoted in the reports of the lecture seem to be matters of opinion, and will need to be supported by conclusive

evidence before they are likely to be accepted by archæologists. Such statements are that the buildings are essentially of a native type common to-day; that neither the buildings nor the other articles found show traces of early oriental influence; that the soapstone birds, etc., so often described, represent totems; and others of a similar character. Mr. MacIver believes that the ruins were originally fortified places, usually enclosing a kopje built in the form of a rough ellipse following generally the contour of the surrounding country. The "pit-dwellings" described by previous investigators are held to have originally been citadels round which concentric walls were built. Zimbabwe, as the residence of the sovereign, was more elaborately built than the rest, but its plan was essentially the same. Whatever may be Mr. MacIver's experience as an archæologist, it is difficult to believe that the character of the remains can have been so totally misunderstood by all previous observers, and, in any case, we may be sure that the last word has not been said on the subject.

The Zambezi Bridge.—The great bridge by which the railway is carried across the Zambezi just below the Victoria falls was formally opened by Prof. G. Darwin, President of the British Association, on September 12, with due ceremony. At a dinner which took place the same evening, the health of Sir C. Metcalfe, the eminent engineer under whose direction the great work has been carried out, was proposed by Prof. Darwin.

Irrigation in Cape Colony.—A report by the Director of Irrigation on works and localities in the north-west districts of Cape Colony, visited by him in June–July, 1904, contains some interesting geographical items. Between Britstown and Prieska, Tigerpoort Vlei, a flat of some 5000 acres of fertile alluvial soil and small surface slope, was found capable of being brought under flood-irrigation by means of a short canal taking off from the left bank of the Brak river, the cost of the construction of which would be amply repaid by the returns. As a river the Brak is of recent origin. Where the river now is, there was, some fifty to sixty years ago, a series of reed-bordered pools fed by the waters straggling over the intervening flats. The low-lying lands along this watercourse became in this way thoroughly saturated at every flood, covered with thick grass and bush, and even in years of drought afforded valuable grazing and plentiful supply of drinking-water. To-day the river channel has a mean width of 240 feet, and a depth of 15 feet, and it is only a very extraordinary flood, like that of September, 1901, which tops the banks of the river and spreads over the valley lands. Such floods are of short duration, and, with a deep channel affording a free outfall for the drainage, the soil and subsoil soon lose their moisture. One bad drought withers up the grass and seriously injures the bush. Yet, the slope of the country being sufficiently flat, there should be no great difficulty in restoring the lands to their original pastoral condition, or, where the soil is deep enough, in bringing a large portion of them under the plough. Since November, 1903, the Brak had been in flood at least five times. Early in November, and once again before Christmas, it ran 1½ foot deep for two or three days. In January it was impassable for three days, and continued in flow for nineteen or twenty days. Between January and March it came down twice, carrying a good supply for a week. A gauge has been erected in the river near Kaffir's Poort, and readings are to be taken while the river is in flow. From Prieska a descent was made of the Orange river to Upington. Six miles lower the river runs in a roomier valley 2 to 6 miles wide. Flowing with reduced velocity, it has deposited its silt and formed on each side of its present main stream a series of islands, extending 60 miles in length, intersected by innumerable sluits down which the water spills when the river rises in flood. Together with the alluvial tracts on the adjoining mainland, this land is roughly estimated to comprise 60,000 acres of exceedingly fertile

irrigable land. Leaving the Orange river and ascending the Hartebeeste, crossed by a dam at Rooiberg, halt was made at Van Wyk's Vlei, where there is a dam collecting the drainage from a catchment of about 800 square miles. On the way thence to Brand Vlei, inspection was made of various "Saai dams"—low embankments thrown across a flat valley to pen in water and ensure a sufficiency of moisture for the germination and sustenance of a crop. A form of irrigation extensively used in India, it was here for the first time encountered in the country of the Cape. The remainder of the tour traversed the Zak, Fish, and Doorn rivers, terminating at Ceres.

AMERICA.

The Course of the Tennessee River.—After flowing south-west in an open longitudinal valley to a point near Chattanooga, the Tennessee river makes a sudden bend to the west, and flows for some distance through a winding gorge before again resuming its original direction in a second longitudinal valley. These features have been explained, by Dr. Welland Hayes, Mr. M. R. Campbell, and others, as due to a striking instance of river capture at the close of the Tertiary period, it being held that the Tennessee river formerly held on its south-west course past Chattanooga into the Coosa river, and so on to the Alabama, the diversion being due to the cutting back by one of the tributaries of the Sequatchie through the high flat-topped Walden ridge. These views, which have been very generally accepted by geologists, have lately been challenged—first by Mr. C. H. White, who developed his objections in the *Journal of Geology* (Chicago), vol. 12, pp. 34–39, and more recently by Mr. D. W. Johnson, who clearly sums up the arguments for and against the theory of capture in the same *Journal* for April–May of the present year (vol. 13, No. 3). Mr. Johnson, who has made a close study of the subject of river-capture in general, as well as the previous literature on the Tennessee river, has also personally examined the locality of the supposed capture. Among the arguments in favour of this, the principal are—the indistinct character of the divide now separating the Tennessee from the Coosa south of Chattanooga; the correspondence of the volume of material deposited by the Alabama during Tertiary times with that eroded by the upper Tennessee and Coosa; and the youthful character of the gorge. It is shown, however, that these facts are not inconsistent with the idea that there has been no change in the general course of the Tennessee since the close of the Cretaceous period, while it is held that many facts tell in favour of this idea and against that of capture. Thus the winding nature of the gorge seems to imply that the meanders were developed when the river flowed at a higher level over the Cretaceous peneplain now represented by the Walden ridge, while the difference in level between the Sequatchie and upper Tennessee valleys seems insufficient to have enabled a tributary of the former to cut back across the dividing ridge. On the whole, the balance of evidence certainly seems against the theory of capture in this case.

The Water-level of the Great Lakes.—In connection with the unusual level reached by the great lakes during the high water of 1904, Prof. A. J. Henry sketches, in the *Monthly Weather Review* for February, 1905 (Washington, April 25), the *régime* of the fluctuations of level in the lakes as deduced from the records of the past ten years. He shows that there is a regular annual fluctuation which brings the waters to a maximum in summer, followed by a decline to a minimum in winter or spring. There is also another series, superimposed on the first, which generally extends through several years, an upward tendency being maintained through several successive seasons. The annual rise begins with the breaking up of ice in the rivers and streams, and the maximum is generally reached in

midsummer, the rise, however, being somewhat retarded in the case of Lake Superior as compared with the more southerly lakes. As soon as high water is reached the level begins to fall, at first slowly, but quite rapidly as winter approaches. The chief agents in both series of changes are naturally atmospheric influences—precipitation, temperature, and evaporation. The winter temperature is important, as evaporation is greatly increased in a warm winter. Thus Prof. Henry calculates that the difference in amount of evaporation may reach as much as 3·5 inches. Changes of level may also be due to alterations in the outlets, in the case of Huron and Erie, but in the case of Superior atmospheric conditions seem the ruling factor. An unusually low level was reached in all the lakes in 1895, the extreme range between this and 1904 being about 3 feet on Ontario. This low level, caused by persistent drought, coupled with periods of abnormally high temperature and greatly increased evaporation, made its influence felt for several years, the loss being only made good after a continuance of favourable conditions. Thus high water was not again reached on Lake Superior until 1899.

Indian Shell-mounds in Southern Brazil.—The shell-mounds which form so marked a feature on the Atlantic coast of Central and South America are described and illustrated by G. von Koenigswald in the issue of *Globus* for June 1, 1905 (vol. 87, No. 20). These mounds, known in Brazil by the Indian name "sambaqui" (= shell mountains), have been much drawn upon, both by the natives and by the Jesuits during the time of their ascendancy in this region, for the construction of modern buildings, and many have been almost entirely removed, though vast accumulations of mollusc-shells still remain. The position of the primitive settlements which they represent was carefully chosen on the shores of bays in which fish and molluscs abounded, being placed on small rising grounds screened from view, seawards, by the mangrove fringe along the swampy shore. Where the settlements were placed in low-lying tracts, the shell-heaps themselves formed the solid foundation on which the dwellings were placed. In these cases, which are by far the most numerous, the mound was flat and broad, whereas in places where a natural elevation existed for the location of the settlement, the form is more conical. The author of the paper has examined some 150 sambaquis between Rio and the borders of Uruguay, some of them reaching a height of 60 feet and over. The objects found in the mounds bear witness to the varying degree of culture possessed by the successive inhabitants, the stone implements associated with the lower layers being of the most primitive description, while at higher levels they are skilfully worked and polished. It is a remarkable fact that the ancient distribution of the tribes revealed by a study of the implements corresponds closely with that observed by the Portuguese on their first arrival.

New Administrative Division of Colombia.—The July number of *La Géographie* records some administrative changes lately introduced in Colombia. Four new departments have been created, viz. Galan (chief town San Gill), Caldas (Manizales), La Plata (La Plata), and l'Atlantico (Barranquilla). The city of Bogota has been dissociated from the province of Cundinamarca and made into a "district capital," but the chief town of the province has not yet been fixed.

AUSTRALASIA AND PACIFIC ISLANDS.

Pitcairn Island.—According to a Colonial Report (Misc. No. 30), the Pitcairn islanders number 77 males and 92 females. Among themselves they speak a patois the peculiarity of which is traceable back to the Tahitian women, who, with the mutineers of the *Bounty*, occupied the island in 1870. Yet most of the adults speak English fairly well. Converted some years ago into Seventh-day Adventists, the islanders scrupulously observe their sabbath day, and attend

prayer meetings and pay tithes, but apparently without mending their too notorious deviations in the way of immorality, theft, and brawling—vices in their case not due to the use of intoxicants. The prevalent diseases are consumption, lupus, glandular swellings, asthma, and skin affections. It is noted that the front teeth are mostly bad. Since becoming Adventists they possess no pigs, but have been advised to start breeding them. Having neither copra (the island producing no coconuts) nor shell for disposal, and only a precarious rainfall, the people are poor. Coffee, however, of superior quality grows luxuriantly, and with pigs and coffee for export, direct communication might be established with Tahiti. At present there is but a poor cutter plying between this island and Mangareva. Pitcairn also grows excellent arrowroot, and, with proper machinery and appliances, might yield 250 tons per annum.

POLAR REGIONS.

The Voyage of the Duke of Orleans.—News received in Sweden early in September from Reykjavik, in Iceland, announced that a successful voyage to the east coast of Greenland had been made by the Duke of Orleans and his party on board the *Belgica* (*Journal*, July number, p. 90). The expedition had reached a higher latitude than is positively known to have been attained from the east on this side of Greenland, the farthest being in 78° 16′ N., or considerably to the north of Cape Bismarck, discovered by the German expedition under Koldewey in 1870. Cape Bismarck itself was found to be not on the mainland, but on an island, the Dove bay of the German expedition being thus in reality a strait. Since the time of that expedition this northern section of the East Greenland coast had been little visited, though Captain Naero is said to have reached 75° 30′ N., or just north of Shannon island, in a Norwegian whaler in 1900 (*Pet. Mitt.*, 1900, p. 220). It will be remembered that a point on this coast still further north was said to have been reached by the old whaler Lambert in 1670; while Daines Barrington also spoke of a high latitude having been reached on the same coast in the eighteenth century; but these reports must be considered as exceedingly doubtful. Some good oceanographical work is said to have been accomplished by the Duke of Orleans' party, which included some competent observers.

The Ziegler Arctic Expedition.—On landing at Hull, on his way home to America, Mr. Fiala communicated to Reuter's representative an outline of the chief events of his expedition, which makes it possible to add some details to the statement made in the September number of the *Journal*. After leaving Vardo on July 10, 1903, the *America* encountered great difficulties from the state of the ice before reaching Franz Josef Land, steaming east until close to Novaya Zemlya without finding an opening. Only on August 12 was it possible to make Cape Flora, Teplitz bay being reached by the end of the month, and a base camp established there. It was named Camp Abruzzi. After narrowly escaping destruction on October 22, the *America* was crushed by the ice on November 21. On January 22, 1904, a violent gale brought a further disaster, the ship finally disappearing, as well as a quantity of coal and provisions that had been cached on the ice. The high temperature which prevailed kept the sea open off the north-west coast of Rudolf island during almost the entire winter, and two sledge expeditions which started in March, the second of which made its way to the sea ice past Cape Fligely, had to return completely baffled. Leaving a small party of volunteers at Camp Abruzzi to renew the attempt the following year, Mr. Fiala went to Cape Flora to await the relief ship, but when all hope of succour had been given up, he returned to Camp Abruzzi to make preparation for another sledge expedition northwards in 1905. The journey occupied a month, and during the latter

part of the way the rough channel ice had to be crossed in dense darkness. The weather in 1905 proved worse than in 1904, the abnormal warmth making the ice exceedingly dangerous. The new attempt proved equally a failure, but a party under Mr. Porter (third in command) did some exploring and mapping to the south. Scientific work was also continued without interruption at Camp Ziegler, whither the bulk of the expedition was transferred, and where the news of the arrival of the *Terra Nova* reached the leader on August 1. The explorers had been cut off from the rest of the world for two complete years.

MATHEMATICAL AND PHYSICAL GEOGRAPHY.

The Indian Ocean Expedition.—Prof. Sedgwick has communicated to *Nature* (August 10, 1905) a letter received by him from Mr. Stanley Gardiner, giving an account of the progress of the expedition in the *Sealark* for the scientific exploration of the Indian ocean down to about the end of May. Soundings taken during that month between the Maldive and Chagos groups had not confirmed the existence of a bank between the two groups, which the soundings of the *Valdivia* Expedition had indicated as possible. A depth of more than 2000 fathoms was obtained, and though this is small compared with the depths both to the east and west, Mr. Gardiner remarks that one obviously cannot build up any views of a possible former connection of the Maldive and Chagos banks on such a slender basis. During the passage, samples of the sea-water were taken, and of the pelagic organisms existing at varying depths. On May 19 the *Sealark* reached the Ile de Diamant, Percs Banhos atoll, but the exposure of this atoll to the force of the south-east trades then prevailing made it necessary to postpone a thorough examination of it. It was therefore decided to move to the Salomon atoll, nearly enclosed by a surface reef, and here a camp was formed on shore. While Mr. Gardiner and his colleague, Mr. Cooper, collected the marine flora and fauna and examined the reefs and land, Captain Somerville and the officers of the *Sealark* made a fresh large-scale chart of the atoll, and Mr. Fletcher and Dr. Simpson collected insects and land-plants. Mr. Gardiner was struck by the absence of life on the reefs, for though there are plenty of corals in places, the number of species is quite limited. He was endeavouring to obtain light on the physical conditions prevailing, so as to find an explanation of the paucity of free-living animals. The *Sealark* was about to proceed to Diego Garcia to coal, Mr. Cooper going in the ship to examine the land and reefs. The observations of the land-plants had brought out some interesting facts as regards their local distribution, definite zones with their own special plants being found on most of the islands.

Volcanic Action and the Permanence of Ocean Basins.—A collection of rocks recently brought to Cape Town from Tristan da Cunha serves Mr. E. H. L. Schwarz, of the Geological Survey of Cape Colony, as the text for a discussion of various controversial subjects connected with the physics of the Earth's crust. While most of the rocks collected are similar to those brought from the island by the *Challenger* Expedition, there is a novelty of some interest in the form of a block of gneiss picked up in the neighbourhood of the settlement at Edinburgh. That this rock was not brought to the island by some external agency seems confirmed, in Mr. Schwarz's view, by the occurrence, among rocks from Nightingale island, of fragments of a porphyritic rock embedded in the lavas. They are of minute size, and have evidently been derived from the shattering of a foreign igneous mass of an acid type by explosions, such as occur in the throats of volcanoes, and thus cannot have been drifted to the island. While allowing that the evidence is not as good as one could wish for, Mr. Schwarz thinks it reasonable to suppose that this granite belongs to the islands, and that it, with the gneiss above mentioned,

is an indication that rocks of a continental type exist in them side by side with those of purely volcanic origin, which have been held to be typical, with few exceptions, of oceanic islands. This would be a somewhat slender foundation on which to build an argument against the permanence of ocean basins; but the writer founds his conclusions on other facts brought to light in many parts of the globe, which he summarizes as recorded in an extensive literature. Still, it must be confessed that his arguments do not greatly affect the position of the problem, which will continue to be warmly debated by the champions of the rival theories. Of the instances of oceanic islands containing continental types of rock, few are not more or less in association with one or other of the submarine continental plateaus. The most important exception is that of Ascension, to which, if Mr. Schwarz's assumption is correct, Tristan da Cunha may now be added. But on other grounds the probability of a former connection between the lands on opposite sides of the South Atlantic has long been granted, so that this may to some extent be considered outside the controversy. In any case, the existence of continental rocks in oceanic islands would merely show that the permanence of ocean basins is not to be regarded as absolute, which few even of the upholders of the theory would venture to do. It is far from justifying the idea of a perpetual see-saw between the oceans and continents. Mr. Schwarz's discussion of volcanic action generally rests on a somewhat broader basis, owing to his personal acquaintance with many of the old volcanoes of South Africa. He gives many instances of non-volcanic matter being brought up by volcanic eruptions, and of eruptions which can be shown to have been accompanied by no great amount of heat. The solid rocks brought up in volcanic pipes show, in his view, that the chimneys cannot have their origin in really profound depths, or tap a problematical molten magma, but he considers them due to the heat caused by the crushing of rocks along structural lines, which are thus the actual seat of the fusion, instead of merely supplying the vents for the molten matter. This revives the theory of Mr. Mallet, which he holds to have been rejected on insufficient grounds.

Influence of Height above Sea-level on the Light-absorption of Plants.—In the *Sitzungsberichte* for February, 1905, of the Imperial Academy of Sciences in Vienna (Mathemat. Naturwissens. Klasse), Prof. Julius Wiesner gives the results of his investigations into the light-appropriation of plants in the Yellowstone and other regions of North America. The author, who for six years has been prosecuting his studies on absorption of light by plants in its dependence on geographical conditions, has now, with the assistance of the Imperial Academy of Sciences, supplemented them by an investigation into the influence of height above sea-level on the mode and extent of such absorption. The studies on the influence of geographical latitude were extended to 6° S. and 79° N. lat., and the results have from time to time been made public (see note on "Light and Vegetation in the Arctic" in *Journal*, June, 1901, p. 665). For the later, as for the earlier, investigations a suitable locality was not found in Europe. Vegetation ceases at relatively too low heights above sea-level, as in the Alps, or, as in the Southern European mountain chains, there are too few high plains suitable for observation. Only the Rila mountain chain in South Bulgaria would, in the opinion of Prof. L. Adamović, of Belgrade, constitute an exception in this respect. The high regions in the Yellowstone territory of the United States were found, however, to offer far better opportunities, and observations were here made along a section of country 560 miles in length, with a difference of level amounting to 8200 feet. It extended from Bismarck on the Missouri, in North Dakota, to the north-west end of the National Park. The main results of the investigations are as follows: With a rise in height above the sea-level, not only is the intensity of the total daylight

increased, but also the intensity of the direct sunlight as compared with diffused light. Whereas the further the plants of the Arctic Regions press towards the pole the more of the total light do they strive to obtain, the plants ascending upwards act correspondingly only up to a certain height. Above this, on the contrary, they avail themselves of the proffered light to a progressively less extent. This is indicated in the cypress-shaped form of conifers, such as the *Pinus Murrayana*, the commonest tree of the Yellowstone Park. In the case of the cypress proper, this form wards off the most intense rays of the vertical sun of the south, while in that of these high mountain pines it wards off the rays of which the intensity is due to the height above sea-level. The injurious effect of the vertical radiation is shown by the fact that plants which in lower situations, under otherwise like conditions, preserve their leaves, are at these heights subject to the fall of the leaf. The Arctic limit for the life of a plant will occur where maximum and minimum of light-absorption coincide, as, according to Prof. Wiesner's own observations, for Betula nana, in Spitzbergen. An altitudinal limit determined by light for the growth of a plant is not, however, to be established, seeing these relations are much more complicated than those having reference to Arctic limit. In the case of the latter, the question concerned only a vegetation continuing at a uniform level—close to that of the sea. The influence of elevation, on the other hand, is confused by the change of latitude, seeing that with decreasing latitude vegetation mounts to ever greater heights, the direct radiation to which it is exposed increasing in proportion. Some observations instituted at great heights (as high as 13,400 feet), on Pike's peak, closely suggest the question whether the plants which mount to great altitudes above sea-level do not reduce their maximum of light-absorption, so that the maximum and minimum of the requirement of light approach each other or possibly coincide. This would avail as a further defence against strong light. A solution of this question could be obtained only at a great height above sea-level in very low latitudes.

GENERAL.

The London School of Economics.—We have received the 'Calendar' of this institution for 1905–6, covering the eleventh session since its foundation, and giving, besides a short account of its aims and methods, a full list of the courses of lectures and other forms of instruction for the academical year now opening. The school, which is virtually the only institution at which a commercial education of the highest grade can be obtained in this country, is carrying on a most valuable work, and even though its aims are more strictly utilitarian than some other educational agencies, the exceptionally strong staff of lecturers whose services are at its disposal is a guarantee that the subjects will be studied in a way that will bring out their full educational value. Under its present director, Mr. Mackinder, the claims of geography to the attention of those contemplating a career connected in some way with commerce or economics are thoroughly safe, and the list of lectures, etc., provided under this head is an encouraging evidence that some headway is being made in the improvement of geographical teaching in this country. Although special prominence is, of course, given to the commercial bearings of the subject, the whole teaching is, as it always should be, based on physical geography, and the courses will thus supply an excellent general training to teachers and others who may join the school without proceeding to one of the degrees of the University of London. Besides the 'Calendar,' a pamphlet is issued specifying the courses of special interest to students of geography, and this may be obtained on application to the Director of the School, Clare Market, W.C.

The Oxford School of Geography.—The syllabus of arrangements for the term now beginning shows that under the new Reader, Dr. Herbertson (who was

appointed to the post vacated by Mr. Mackinder early in the summer), the work of the Oxford School of Geography will be carried on with undiminished energy. From his previous important services to the school as Lecturer in Physical Geography, Dr. Herbertson is better qualified than any one to carry on the work of his predecessor, and the continuity of aim and method thus secured will be a great advantage. The list of proposed lectures and classes shows that a thorough grounding in the principles of geography will be given to the students who attend, and the close personal supervision exercised by the Reader, and the due provision for practical work and informal discussions of points of current interest, augur well for the future of the school. In addition to the reader's lectures and classes, courses of personal instruction will be given by Dr. Grundy, Mr. Beazley, Mr. J. L. Myres, and the newly appointed instructor in surveying, Mr. N. F. Mackenzie. The term's work will open on October 16, when the Reader will see intending students at the Old Ashmolean building from 11 a.m. to 1 p.m.

Death of Tippu Tip.—The famous Arab trader, with whom so many of the great African explorers from the time of Cameron and Stanley onwards were brought into relation, died at Zanzibar on July 14 last. The part played by this bold adventurer in Stanley's great journey down the Lualaba-Congo will be remembered by all readers of 'Through the Dark Continent.' Most travellers have borne witness to the courtesy and straightforward character of the Arab trader, who was of a distinctly higher type than the majority of the adventurers by whom Central Africa was overrun during the latter half of the nineteenth century. Sketches of his life and character, with portraits, are given in the *Mouvement Géographique* for June 18 last, and in the *Deutsches Kolonialzeitung* of July 15. Tippu Tip's grandfather hailed from Maskat, and both he and his son Mohamed bin Juma took prominent parts in the establishment of Arab influence in East Africa in the middle of last century.

Elisée Reclus—Obituary. Erratum.—Page 342, for *facsimiles* read *fascicules*.

OBITUARY.

Captain Joseph Wiggins.

It is with much regret that we have to record the death of Captain Joseph Wiggins, at Harrogate, on September 13. Captain Wiggins acquired a wide reputation during the last quarter of the nineteenth century by his enterprise in opening up communication with North-Western Siberia by way of the Kara sea. It was on his skill as a navigator that Captain Wiggins's fame rested. Born in 1832, the son of a Norwich coach proprietor who died some ten years later, the boy had early to seek his living, and entered the mercantile marine when thirteen years of age. He rapidly rose in his profession, and gained his master's certificate, and, after experience in various parts of the world in command of sailing vessels and steamers, was in 1869 appointed Board of Trade examiner in seamanship for the ports of South Shields and Sunderland. Two years later, in 1871, Captain Wiggins became a Fellow of the Royal Geographical Society. Among other seas in which he had sailed was the Baltic, and he took a keen interest in the development of the vast resources of the Russian Empire. In particular, the question of establishing improved communications with the interior of Siberia greatly exercised his mind, and he conceived the idea of avoiding the long overland journey by a voyage through the Kara sea and up the great gulfs and rivers that penetrate to the heart

of Asiatic Russia. The route was then entirely unfollowed, but its claims were beginning to attract attention, and in the early seventies a Russian merchant offered a reward to any one who would open up trading relations by sea between Europe and the Obi river. Captain Wiggins seized the opportunity of putting his long-cherished schemes to the test, and resigned his official appointment. Voyages undertaken in 1874 and 1875 at his own expense were unsuccessful, in so far as that he was not able to ascend either the Obi or the Yenisei; but they resulted in the acquisition of much useful information about the navigation of the Kara sea, and paved the way to success. A third voyage, undertaken with financial assistance in 1876, on board the *Thames*, a vessel of 120 tons register, did not end until Yeniseisk was reached, 900 miles as the crow flies inland from the head of the Gulf of Yenisei. During the next twenty years various other voyages by Captain Wiggins to the rivers Obi and Yenisei confirmed his theory as to the practicability of the Kara sea route to Siberia. Once, in 1894, he lost his vessel in the Kara sea; but the loss was not due to ice, but to fog and to an unexpected current. The opening-up of the route, however, excited strong opposition among those interested in the overland trade, and practically nothing has been done to follow up Captain Wiggins's enterprise. None the less, his skill and courage received widespread recognition both in Russia and in this country. He lectured before the Imperial Russian Geographical Society at St. Petersburg, and was presented by the Emperor Alexander III. with a service of silver plate. King Edward (then Prince of Wales) manifested great interest in the voyages, and received the navigator at Sandringham; while in 1894 Captain Wiggins was awarded the Murchison Grant by the Council of the Royal Geographical Society.

CORRESPONDENCE.

Marco Polo's Travels.

I. Did Marco Polo visit Baghdad?

In connection with the third edition of Yule's 'Marco Polo,' which has been recently edited by the well-known French geographer, M. Henri Cordier, it seems desirable to discuss some points which I have raised in my 'Ten Thousand Miles in Persia,' chap. xxiii., which chapter the French savant has referred to in various portions of the new edition. Chief among these questions is whether Ser Marco visited Baghdad. Not only is this important from the geographical point of view, but the question is one which, to a considerable extent, affects the veracity, or at any rate the accuracy, of the illustrious Venetian to no small extent. Consequently, it is a question which, in my humble opinion, should be settled without, if possible, leaving any doubt on the subject, and this I trust to be able to succeed in accomplishing.

Sir Henry Yule, in his introduction (vol. 1, p. 19), traces out the following itinerary for the travellers, viz. Ayas, on the Gulf of Scanderoon, and thence to Sivas and Mosul, from which point the Tigris was followed to Baghdad. From Baghdad the travellers, according to Yule, descended the Tigris and the Persian gulf to Hormuz.

This view I was, and am, unable to accept for the following reasons: Firstly, is it not unlikely that Marco should term the Volga the Tigris?* Secondly, in

* *Vide* vol. 1, p. 5 (2nd and 3rd editions).

describing the Caspian sea, the statement is made that "into it flows the great river Euphrates." *

Now, we know that Marco Polo never crossed the Volga nor saw the Caspian sea, and I hold that these colossal errors in geography are impossible, if we suppose that he travelled down the Tigris for many hundreds of miles, past its junction with the Euphrates. Any other view would surely lower the great traveller's reputation.

Let us, in the next place, examine the references he makes to Baghdad, or Baudas. Here he merely mentions that "Baudas is a great city, which used to be the seat of the Calif of all the Saracens in the world, just as Rome is the seat of the Pope of all the Christians." † The manufactures of Baghdad are indeed given, but no mention is made of the buildings, and, generally speaking, the whole description is meagre compared with his account of far less important cities, such as Yezd and Kerman. There is indeed a reference to the capture of the city by Alaü, or Hulaku Khan, but this, I would urge, by no means adds probability to Yule's views, as the echo of that grim tragedy must have resounded throughout all Asia and Eastern Europe.

Another point, albeit a minor one, is that, had Baghdad been the objective, would the travellers have taken so circuitous a route *viâ* Sivas, whereas, if we suppose them to be making for Tabriz, which was already beginning to attract through traffic at the expense of Baghdad, this route is more or less a natural one?

The above arguments are, however, but minor, if we consider the utterly inaccurate description of his supposed onward journey. To quote the text: "A very great river flows through the city, and by this you can descend to the Sea of India. There is a great traffic of merchants with their goods this way; they descend some eighteen days from Baudas, and then come to a certain city called Kisi, where they enter the Sea of India. There is also on the river, as you go from Baudas to Kisi, a great city called Bastra, surrounded by woods in which grow the best dates in the world." ‡

Now, in both these paragraphs there is separate and independent mention and inference that Kisi is at the mouth of the Sea of India or the Persian gulf, whereas it is situated some 400 miles from the mouth of the Shatt-al-Arab, which is the name given to the united streams of the Tigris and Euphrates.

Would Marco Polo have been guilty of such an astounding statement? Having studied his works carefully in parts where I can check it, I unhesitatingly answer in the negative.

This view is, I would urge, supported by a second reference to Kis, in which, on his return journey from China to Europe, he describes its position as regards the city of Calatu. The reference runs: "First, however, there is a point that I have omitted; to wit, that when you leave the city of Calatu and go between west and north-west a distance of 500 miles, you come to the city of Kis." §

Is it, I would ask, likely that Ser Marco would give this description of the position of Kis, or Kisi, if he had already touched at it on the way to Hormuz, his previous reference to which he mentions? One further point is that, if we accept Sir Henry Yule's views, the description of the route from Yezd to Kerman and thence to Hormuz must have been written in the reverse way to that in which Marco travelled, and this is surely out of the question, and by itself furnishes almost sufficient proof of the correctness of my views.

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* Vol. 1, p. 52.
† *Ibid.*, p. 63.
‡ *Ibid.*, chap. vi. p. 63.
§ Vol. 2, p. 452.

It remains to add that Sir Henry Yule, in his note on the subject, wrote, "Polo is here either speaking without personal knowledge or is so brief as to . . . ;" and again, "I am inclined, however, to think that this was from not having visited it, *sc.* Kisi." In the plate entitled "Probable view of Marco Polo's own Geography," * the itinerary is not shown as running to Baghdad. M. Cordier, however, in referring to this important subject, quotes from my work, but in my opinion hardly meets my points in his note, which runs as follows: † —

"Major Sykes, in his remarkable book on Persia, chap. xxiii. pp. 262, 263, does not share Sir Henry Yule's opinion regarding this itinerary, and he writes: 'To return to our travellers, who started on their second great journey in 1271, Sir Henry Yule, in his introduction, makes them travel *viâ* Sivrcs to Mosul and Baghdád, and thence by sea to Hormuz, and this is the itinerary shown on his sketch-map. This view I am unwilling to accept for more than one reason. In the first place, if, with Colonel Yule, we suppose that Ser Marco visited Baghdád, is it not unlikely that he should term the river Volga the Tigris, and yet leave the river of Baghdád nameless? It may be urged that Marco believed the legend of the reappearance of the Volga in Kurdistan, but yet, if the text be read with care, and the character of the traveller be taken into account, this error is scarcely explicable in any other way than that he was never there.

"'Again, he gives no description of the striking buildings of Baudas, as he terms it, but this is nothing to the inaccuracy of his supposed onward journey. To quote the text, "A very great river flows through the city, . . . and merchants descend some eighteen days from Baudas, and then come to a certain city called Kisi, where they enter the Sea of India."

"'Surely Marco, had he travelled down the Persian gulf, would never have given this description of the route, which is so untrue as to point to the conclusion that it was vague information given by some merchant whom he met in the course of his wanderings.

"'Finally, apart from the fact that Baghdád, since its fall, was rather off the main caravan route, Marco so evidently travels east from Yezd and thence south to Hormuz, that, unless his journey be described backwards, which is highly improbable, it is only possible to arrive at one conclusion, namely, that the Venetians entered Persia near Tabriz and travelled to Sultania, Kashan, and Yezd. Thence they proceeded to Kermán and Hormuz, where, probably fearing the sea voyage, owing to the manifest unseaworthiness of the ships, which he describes as "wretched affairs," the Khorasan route was finally adopted. Hormuz, in this case, was not visited again until the return from China, when it seems probable that the same route was retraced to Tabriz, where their charge, the Lady Kokachin, "moult bele dame et avenant," was married to Ghazan Khan, the son of her *fiancé* Arghun. It remains to add that Sir Henry Yule may have finally accepted this view in part, as in the plate showing "Probable View of Marco Polo's own Geography," the itinerary is not shown as running to Baghdád.'

"I may be allowed to answer that when Marco Polo *started* for the East, Baghdad was not rather off the main route. The fall of Baghdad was not immediately followed by its decay, and we have proof of its prosperity at the beginning of the fourteenth century.

"Tauris had not yet the importance it had reached when the Polos visited it on their *return* journey. We have the will of the Venetian Pietro Viglione dated from Tauris, December 10, 1264 (*Archiv. Veneto.*, 26, 161–165), which shows that he was but a pioneer. It was only under Arghún Khan (1284–91) that Tauris became the great market for foreign, especially Genoese, merchants, as Marco Polo remarks on his return journey; with Ghazan and the new city built by that prince, Tauris reached a very high degree of prosperity, and was then really the chief emporium on the route from Europe to Persia and the far East.

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* Vol. 1, p. 107. † P. xix. of Introduction to vol. 1.

"Sir Henry Yule had not changed his views, and if in the plate showing 'Probable View of Marco Polo's own Geography,' the itinerary is not shown as running to Baghdad, it is mere neglect on the part of the draughtsman."—[H. C.]

It is to be noticed that in the above note M. Cordier hangs his reply mainly on the fact that Baghdad was more and Tabriz less important at that particular period than I had imagined. Here I am ready to bow to superior knowledge, albeit the fact is not fully proved; but the main points of my argument remain, in my opinion, unanswered, and, with all respect to M. Cordier, I think that this matter should be fully discussed, and not dismissed by a reference to the supposed neglect of a draughtsman. Personally, I consider Marco Polo to have been a shrewd observer and incapable of confusing the Tigris with the Volga, and of making the Euphrates—this is really a second confusion with the Volga—discharge into the Caspian sea, except on the supposition that he was writing on hearsay. Consequently I hold it that he passed by a route where he could not make personal inquiries into these questions, and this route would be the one selected by me.

To conclude, I maintain that Marco Polo entered Persia near Tabriz, whence he travelled to Sultania, Kashan, Yezd, Kerman, and Hormuz. From that port, owing to the unseaworthiness of the vessels, the presence of pirates, the fact that the season was past, or for some other reason, he returned by a westerly route to Kerman, and thence crossed the Lut to Khorasán.

Did Marco Polo visit the Tabas?

A section of Ser Marco's journey on which I have gained some recent information is that portion which lies between Kermán and the north. As far as Cobinan, still known as Kubanán, there is no doubt as to the identity of the place, even if the route adopted is not absolutely certain. Consequently we have now to deal with the onward section to Tunocain. Before proceeding farther, I will quote the text which runs, "When you depart from this city of Cobinan, you find yourself again in a desert of surpassing aridity, which lasts for some eight days; here are neither fruits nor trees to be seen, and what water there is is bitter and bad, so that you have to carry both food and water. The cattle must needs drink the bad water, will they nill they, because of their great thirst. At the end of those eight days you arrive at a province which is called Tonocain."* I was under the impression that a route ran direct from Kubunán to Tabas, but when visiting this latter town a few months ago I made careful inquiries on the subject, which elicited the fact that this was not the case, and that the route invariably followed by Kubunán-Tabas caravans joined the Kermán-Rávar-Naiband route at Cháh Kuru, 12 miles south of Darbana. It follows this track as far as Naiband, whence the route to Tabas branches off; but the main caravan route runs *viâ* Zenagan and Duhuk to Tun. This new information, I would urge, makes it almost certain that Ser Marco travelled to Tun, as Tabas falls to the west of the main route. Another point is that the district of Tabas only grows four months' supplies, and is, in consequence, generally avoided by caravans owing to its dearness.

In 1893 I travelled from Tun to the south across the Lut as far as Chah Kuru by this very route, and can testify to the general accuracy of Ser Marco's description,† although there are now villages at various points on the way. Finally as our traveller especially mentions Tonocain, or Tun va Kain, one is inclined to

* Yule's 'Marco Polo,' 3rd edit., vol. 1, p. 127.

† The eight stages would be—(1) Hasanábad, 21 miles; (2) Darband, 28 miles; (3) Chehel Pái, 23 miles; (4) Naiband, 39 miles; (5) Zenagán, 47 miles; (6) Duhuk 25 miles; (7) Chah Khusháb, 36 miles; and (8) Tun, 23 miles.

accept this as evidence of first-rate importance, especially as it is now corroborated by the information I gained at Tabas. The whole question, once again, furnishes an example of how very difficult it is to make satisfactory inquiries, except on the spot.

P. Molesworth Sykes, Major,
June 29, 1905. H.B.M.'s Consulate-General, Meshed.

The Masai Uplands.

Nandi, British East Africa, May 14, 1905.

In reference to the sketch-map of Mr. C. W. Hobley, published in the *Journal* of March, 1905, I should like to make the following remarks:—

I made a trip in October, 1903, from the Government station at Nyeri (about 30 miles south-west of Mount Kenya), and marched in a northerly direction, crossing all the rivers forming the eastern watershed of the Aberdare range as far as the Pesi swamp. Thence I crossed the "Markham downs" to El Bor Lossat, and returned to Nyeri from there.

I made a plane-table sketch of the country I traversed, showing every stream I crossed, and it is interesting as filling up a gap between Mr. Tate's journey and that of Mr. Hobley.

The outline of the Pesi swamp I was unable to define accurately, as the whole place was a mass of papyrus, with the ground baked hard by the sun, and with the Pesi river cutting its way through in a deep channel. There can be no doubt that at certain seasons of the year the swamp is a large tract of inundated cotton soil, but owing to the dry season of the year at which I visited it I was able to traverse the whole of it dry-shod! The outline in my map is the extent of the papyrus, and I think coincides with the area of the swamp when inundated to its full extent. I could find no trace of open water. As regards the El Bor Lossat lake, which is a Masai name meaning "the deep swamp," I did not notice the neck of land separating the two lakes which Mr. Hobley marks in his map, and I could not have crossed it anywhere to my knowledge without wading through at least 3 feet of water. The circumference of the lake, marked by a continuous line in my map, is a well-defined bank about 18 inches above the water, which at the narrower end was covered with reeds and long grass, with numerous elephant tracks leading across. Wildfowl of all sorts were numerous. Mosquitoes were a perfect torment.

I notice Mr. Hobley does not mark Mount Korai, which is the high saddle-back hill forming the summit of Satima, the latter being the name of the northernmost block of the Aberdare range.

Nearly all the natural features in this district have both Masai, Dorobo, and Kilungu names; consequently different maps of the same district are extremely confusing, as showing totally different names for the same feature. Swahilis, on the other hand, if asked the name of features (say a river), will give it a name offhand, such as the Hippopotamus river (Nito ya Kiboko), or the Muddy river (Nito ya Topi).

I was travelling on my trip with Masai who had been bred and born on Laikipia, and, consequently, all the names of that district in my map are Masai

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* Map, p. 480.

names. The wat-rshed of the Aberdare range from Mount Korai to Nandarua (Kinankop), and thence south to the Ingong hills, is of considerable interest.

The Morendat river is, I think, the only stream of any size that emanates from the Aberdare range flowing in a westerly direction, and this finds its way into Lake Naivasha in the Rift valley. All the other streams which rise in the Aberdare range find their way, some into the Guaso Nyiro, and thence into the Lorian swamp, and others into the Tana river, and thence to the east coast. It is noteworthy that those streams rising on the west of the Aberdare range turn north and south on reaching the foot of the hills, and, after taking a turn, skirt the extremities of the range and flow east. All the streams that feed the El Bor Lossat rise on the west of the range, and the overflow of this lake flows north and then east, eventually finding its way into the Guaso Nyiro. The rivers Chania and Thika, rising on the west of Nandarua, find their way down the hills in a westerly direction, but as soon as they reach the foot of the hills they turn abruptly south and then east, converging and eventually combining, and joining the Tana river between Donyo Sabuk and the Ithanga hills.

Thus the watershed may roughly be said to be a line drawn from Mount Kibibieri (Gojito of Thomson) in a north-westerly direction, and a line drawn from the same hill in a south-westerly direction, and not the Aberdare range as might be expected.

Further south numerous small streams, such as the Ruiru, rising in the Kitungu hills, flow into the Athi river, which itself rises in the Ingong hills. The Athi river, after entering the plains, flows in a northerly direction, takes a bend round the north of Donyo Sabuk, and goes as near as 2½ miles of the river Thika. It is curious that these two rivers (Athi and Thika), which are amongst the largest of the East Africa Protectorate, should come so close, and their junction or non-junction must have been a mere chance in the open plains, where they now flow, separated only by a strip of grassy flat.

The habit of rivers rising on the western face of a hill and eventually flowing east is further illustrated by the Tana river, which, rising on the west of Mount Kenya, flows south, and, after a large bend to the south, flows east towards the coast, being joined on its way by *all* the streams rising in the Aberdare range south of the Guaso Nyiro, the latter being joined by *all* * the streams rising in the Aberdare range north of itself. South of the rivers Chania † and Thika all streams flow into the Athi river as far as the Ingong hills.

My map illustrates most of the above remarks, including as it does all streams flowing east between Nairobi and the Pesi swamp, and should you deem it of sufficient interest to publish I should feel greatly honoured.

R. Meinertzhazen,
Captain Royal Fusiliers.

P.S.—It might interest you to know that during a recent journey I made from Nandi fort to the Ravine station across the Mau, I was able to see from one point Mounts Kenya and Elgon. Unfortunately, I only had a prismatic compass with me. The summit of Mount Kenya bore 103½°, and the eastern cone of Mount Elgon 325¾°. I must have been nearly 150 miles from Kenya and 80 from Elgon, the two hills being nearly 220 miles apart. My height was over 8800 feet.

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* A small insignificant burn, flowing south of and parallel to the Guaso Nyiro, joins that river. All streams south of this join the Tana river.

† I show two Chania rivers in my map, one flowing into the Tana past Nyeri hill, and the other rising in Nandarua and flowing into the Thika. The above-mentioned one is of course the latter.

Reclus' 'Universal Geography.'

"Aram-Gah," 79, Broadhurst Gardens, South Hampstead, N.W.,
September 5, 1905.

MAY I venture to call your attention to a few little inaccuracies in your obituary notice of Elisée Reclus in this month's *Geographical Journal*? In the distribution of the nineteen volumes of the 'Universal Geography,' you assign *five* to Asia and *four* to America. But if you look again you will see that these figures should be reversed—four to Asia and five to America. In speaking of the author's style, you remark that "naturally much is lost even in the best translation," leaving it to be inferred that there are more than one. But that is not so. There is only one—the first four volumes by Mr. Ravenstein, all the rest by me. Nor did M. Reclus think that "much is lost" in my version, for he wrote: "Clarens, le 29 Janvier, 1882. J'ai lu attentivement une partie de la traduction que M. Keane a bien voulu faire de ma 'Nouvelle Géographie Universelle,' et je suis heureux de lui témoigner ma reconnaissance pour le scrupul qu'il a mis à suivre le texte et pour l'élégance avec laquelle il l'a rendu. J'apprécie aussi pleinement l'avantage d'avoir trouvé en lui un traducteur qui puisse, grâce à sa parfaite connaissance de la matière, corriger ou compléter, en maintes passages, l'original français à l'aide de documents nouveaux.—ELISÉE RECLUS."

A. H. KEANE.

Northern Newfoundland.

I HAVE read with much interest Mr. Thomson's "Notes on a Journey through the Northern Peninsula of Newfoundland," having myself travelled on more than one occasion in the interior of the island. With regard to several points in these Notes, I venture to make a few remarks. Mr. Thompson mentions that he saw no deer whatsoever. This may, perhaps, be explained by the fact that, being summer, they had probably, according to their custom, begun to migrate southwards. I may add that, though in the warm weather I met with many does and calves, especially near Red Indian lake, I rarely saw any stags, as they keep to the woods to avoid the flies.

In 1898, I saw two bears on Exploits river, and on Gambo river, some two years earlier, I saw a beaver's dam, which was certainly occupied. A native who accompanied me had been attacked by a lynx in the same neighbourhood, and also told me that on one occasion he had met with wolves. I only saw one hare, which we killed and ate, but it was not very appetizing.

As to birds, I saw plenty of twillicks, jays, loons, and willow-grouse, and occasionally geese and ducks. The jays used to visit me during meals, and would eat what I threw to them quite close to me; they are known either locally or in Canada by the name of camp-birds. Owls were not wanting; I sometimes wished that they were!

Mr. Thompson makes no mention of flies, mosquitoes, and other biting insects. In the Gambo district I got much bitten by black fly, or some such insect, while in the Exploits country mosquitoes were most troublesome, except on the river-bank, where I never saw one. Whenever I killed deer, bluebottles abounded, and with them came a fly somewhat resembling a wasp.

The chief results of my journeys in this country were the discovery of the last remains of the Beothiks' camping-grounds on the shores of Red Indian lake; and that the Victoria river, described on the map of Newfoundland as a river with only one fall and then smooth water, contained about six falls within a few miles.

I cannot say that I found it an easy country to travel in—at all events in the parts I visited, but very much the reverse. G. D. MCGREGOR.

GEOGRAPHICAL LITERATURE OF THE MONTH.

Additions to the Library.

By EDWARD HEAWOOD, M.A., *Librarian*, R.G.S.

The following abbreviations of nouns and the adjectives derived from them are employed to indicate the source of articles from other publications. Geographical names are in each case written in full:—

A. = Academy, Academie, Akademie.
Abh. = Abhandlungen.
Ann. = Annals, Annales, Annalen.
B. = Bulletin, Bollettino, Boletim.
Col. = Colonies.
Com. = Commerce.
C. R. = Comptes Rendus.
E. = Erdkunde.
G. = Geography, Géographie, Geografia.
Ges. = Gesellschaft.
I. = Institute, Institution.
Iz. = Izvestiya.
J. = Journal.
Jb. = Jahrbuch.
k. u. k. = kaiserlich und königlich.
M. = Mitteilungen.
Mag. = Magazine.
Mem. (Mém.) = Memoirs, Mémoires.
Met. (mét.) = Meteorological, etc.
P. = Proceedings.
R. = Royal.
Rev. (Riv.) = Review, Revue, Rivista.
S. = Society, Société, Selskab.
Sc. = Science(s).
Sitzb. = Sitzungsbericht.
T. = Transactions.
Ts. = Tijdschrift, Tidskrift.
V. = Verein.
Verh. = Verhandlungen.
W. = Wissenschaft, and compounds.
Z. = Zeitschrift.
Zap. = Zapiski.

On account of the ambiguity of the words *octavo*, *quarto*, etc., the size of books in the list below is denoted by the length and breadth of the cover in inches to the nearest half-inch. The size of the *Journal* is 10 × 6½.

A selection of the works in this list will be noticed elsewhere in the "Journal."

EUROPE.

Alps—Structure. *C. Rd.* **140** (1905): 1364–1367. **Lugeon and Argand.**

Sur les grandes nappes de recouvrement de la zone du Piémont. Note de M. Lugeon et É. Argand.

Austria. *Jahrb. Ungar. Karpathen-V.* **32** (1905): 66–75. **Hajnóci.**

Die natürlichen Verhältnisse und der Grubenbau des Zipser Erzgebirges. Von Dr. J. R. Hajnóci. [II.]

Austria. *Deutsch. Rundschau G.* **27** (1905): 346–358. **Lenz.**

Die Insel Brioni bei Pola als Beispiel einer modernen Kulturarbeit. Von P. Lenz. *With Map and Illustrations.*

Austria—Bosnia. **Vogel.**

XX.-XXIII. Jahresb. (1901–4) *Württemberg. V. Handelsg.* (1905): 3–26.

Durch bosnischen Urwald und bosnisches Kulturland. Von Prof. C. Vogel.

Austria—Geology. *M.K.K.G. Ges. Wien* **48** (1905): 196–219. **Hassinger.**

Zur Frage der alten Flussterrassen bei Wien. Von D. Hugo Hassinger.

Austria—Istria. *M.K.K.G. Ges. Wien* **48** (1905): 145–154. **Schneider.**

Ueber die Küstenformen der Halbinsel Istrien. Von K. Schneider. *With Sketch-maps.*

Austria—Population. **Brants.**

B. Classe des Lettres, etc., A. R. de Belgique (1905): 376–381.

Le groupement industriel et les premiers résultats du recensement en Autriche. Par V. Brants.

Baltic. *Geol. Mag.* Decade V., **2** (1905): 311–320. **Howorth.**

The Recent Geological History of the Baltic. Part i. The Litorina Sea. By Sir H. H. Howorth.

Belgium. *C. Rd.* **140** (1905): 1661–1662. **Martel.**

Sur la formation de la grotte de Rochefort (Belgique) et sur la théorie des effondrements. Note de E. A. Martel.

Belgium. *Mouvement G.* **22** (1905): 259–264. **Wauters.**

Le port de Bruxelles et le canal maritime au Rupel. Par A. J. Wauters. *With Map.*

Greece—Ithaca. **Salvator.**

Wintertage auf Ithaka. [By the Archduke Ludwig Salvator.] Prag: H. Mercy Sohn, 1905. Size 15 × 11½, pp. 316. *Plates and Sketches. Presented by the Author.*

Brought out in the same sumptuous style as the Archduke's former publications.

United Kingdom—Coal. **Hull.**

The Coal-fields of Great Britain: their History, Structure, and Resources. With descriptions of the Coal-fields of our Indian and Colonial Empire, and of other parts of the World. By Edward Hull, LL.D., etc. Fifth Edition. Embodying the Reports of the Royal Coal-Commission of 1904. London: H. Rees, 1905. Size 9 × 6, pp. xxii. and 472. *Maps and Illustrations. Presented by the Publishers.*

The preceding edition having for some time been out of print, this will be welcomed as supplying a concise view of the coal question in the light of existing knowledge. The results of the inquiries by the recent commission have been embodied so far as they relate to the subject-matter of the work itself.

United Kingdom—Cotteswold. *Geolog. Mag.* **2** (1905): 216–219. **Callaway.**

The Occurrence of Glacial Clay on the Cotteswold Plateau. By Dr. C. Callaway.

United Kingdom—Coast-erosion. **Carey.**

Minutes of P.I. Civil Engineers **159** (1905): 42–57.

Coast-erosion. By A. E. Carey. *With Maps.*

United Kingdom—Coast-erosion. **Matthews.**

Minutes of P.I. Civil Engineers **159** (1905): 58–142.

Erosion on the Holderness Coast of Yorkshire. By E. R. Matthews. *With Maps and Plans.*

United Kingdom—Forestry. *J.S. Arts* **53** (1905): 529–542. **Maxwell.**

British Woodlands. By the Right Hon. Sir H. Maxwell, Bart., M.P. *With Illustrations.*

Urges the need for reform in British forestry.

United Kingdom—Geology. *B. Assoc. Rep.* (1904): 242–266. ——

Photographs of Geological Interest in the United Kingdom. Fifteenth Report of the Committee.

United Kingdom—Mersey. *B. Assoc. Rep.* (1904): 318–321. ——

The Tidal Régime of the Mersey. Report of the Committee.

United Kingdom—Minerals. **Rudler.**

A Handbook to a Collection of the Minerals of the British Islands, mostly selected from the Ludlam Collection, in the Museum of Practical Geology, Jermyn Street, London, S.W. By F. W. Rudler. London: E. Stanford, 1905. Size 10 × 6, pp. x. and 242. *Price* 1*s. Presented.*

United Kingdom—Rainfall. *Symons's Meteorolog. Mag.* **40** (1905): 21–25. [**Mill.**]

The Rainfall of the Six Months, September, 1904—February, 1905. *With Map.*

The amount was below the average at the great majority of stations during each month of the six, and only in the west of Scotland and Ireland, and in two small areas in western England and Wales did the total reach 75 per cent. of the average.

United Kingdom—Scotland. **Barrow and others.**

Memoirs of the Geological Survey. Scotland. The Geology of the country round Blair Atholl, Pitlochry, and Aberfeldy. (Explanation of Sheet 55.) By G. Barrow, J. S. Grant Wilson, and E. H. Cunningham Craig, with Petrological Chapter and Notes by Dr. J. S. Flett. Glasgow; London: E. Stanford. 1905. Size 9½ × 6½, pp. vi. and 162. *Map and Illustrations. Price* 3*s. Presented by the Geological Survey.*

United Kingdom—Scotland. *Symons's Meteorolog. Mag.* **40** (1905): 29–32. **Dansey.**

The Glacial Snow of Ben Nevis. By Rev. R. P. Dansey. *Illustration.*

See note in the April number (p. 451).

United Kingdom—Scotland. *Scottish G. Mag.* **21** (1905): 264–268. **Mackenzie.**

Pigmies in the Hebrides: A curious legend. By W. C. Mackenzie.

United Kingdom—Scotland. *J. Scottish Meteorolog. S.* **13** (1905): 14–32. **Watt.**

The Rainfall of the Ben Nevis Observatories. By A. Watt.

United Kingdom—Scotland. *Nature* **71** (1905): 583–584. **Watt.**

Inversions of Temperature on Ben Nevis. By A. Watt.

United Kingdom—Scotland. *B. Assoc. Rep.* (1904): 55–60. ——

Meteorological Observations on Ben Nevis. Report of the Committee.

ASIA.

Afghanistan. ———

Index to the Survey of India Department Map of Afghanistan. Scale 1 inch = 16 miles. (No. 152-S.-01.) Compiled in the Intelligence Branch, Quartermaster-General's Department in India. Simla, 1905. Size 10 × 6, pp. 188. *Presented by the Intelligence Branch, Quartermaster-General's Department in India.*

Asia—Historical. *B.S.G. Română* **25** (1904): 80–135. **Nicolescu.**

Primul Călător Român prin Siberia si China. De Miron Nicolescu.

On the journey of the Russian ambassador Spathar in the seventeenth century.

Central Asia—Historical. *Sitzb. K.P.A.W. Berlin* (1905) (1): 238–248. **Franke.**

Hat es ein Land Kharoṣṭra gegeben? Von Dr. O. Franke.

China. *Rev. G.* **29** (1905): 175–180. **Cauquil.**

L'hinterland de Quang-Tchéou-Wan. Par Capitaine Cauquil. *With Map and Illustrations.*

China. *B. American G.S.* **37** (1905): 339–356. **Nichols.**

Notes from the Diary of the late Francis H. Nichols in China. *With Map.*

See note in the September number (p. 331).

China. *J. Tōkyō G.S.* **17** (1905): 1–5. **Ogawa.**

Geographical Researches in North China. By Tahudzi Ogawa. [In Japanese.]

China—Exploration. *Z. Ges. E. Berlin* (1905): 212–214. **Tafel.**

Filchner-Tafel 'sche Expedition. Geologische Beobachtungen auf dem Weg von Hsi-ning-fu über das Quellgebiet des Gelben Flusses nach Sung-pan-ting. Aus einem Brief von Dr. Albert Tafel.

Noticed in *Journal*, vol. **25**, p. 562.

AFRICA.

Egypt—Historical. **Petrie.**

A History of Egypt. [Vol. iii.] From the XIX. to the XXX. Dynasties. By W. M. F. Petrie. London: Methuen & Co., [*not dated*]. Size 8 × 5, pp. xx. and 406. *Maps and Illustrations. Price* 6*s. Presented by the Publishers.*

Madagascar. **Grandidier.**

Collection des Ouvrages Anciens concernant Madagascar. . . . Tome iii. Ouvrages ou extraits d'ouvrages anglais, hollandais, portugais, espagnols et allemands, relatifs à Madagascar (1640 à 1716). Par MM. A. Grandidier et G. Grandidier. Paris, 1905. Size 10 × 6½, pp. 720. *Maps and Illustrations. Price* 25*s.*

See review of first two vols., vol. **25**, p. 449.

Senegal. *C. Rd.* **140** (1905): 744–745. **Chautard.**

Sur les dépôts de l'Éocène moyen du Sénégal. Note de J. Chautard.

South Africa. **Dehérain.**

Henri Dehérain. L'Expansion des Boers au XIX^e^ siècle. Paris: Hachette et Cie., 1905. Size 7½ × 5, pp. 434. *Maps. Price* 5 *fr.* 50. *Presented by the Publishers.*

A useful summary of Boer history, based evidently on a careful study of the authorities, including many original documents.

South Africa. ———

South Africa. Report of the South African Native Affairs Commission, 1903–1905. London: Wyman & Sons, 1905. Size 13½ × 8½, pp. viii. and 98. *Price* 10½*d.*

South Africa—Drakensberg. *Alpine J.* **22** (1905): 362–369. **Browne.**

Notes on the Section of the Drakensberg Mountains from Giant's Castle to Cathkin Peak. By S. G. Browne. *With Map.*

Transvaal. ———

Report of the Transvaal Department of Agriculture, July 1, 1903, to June 30, 1904. Pretoria, 1905. Size 10 × 6½, pp. 404. *Map, Plans, and Illustrations.*

Tunis. *B.S.G. Com. Paris* **22** (1900): 38-46. **Fresnel.**
Le Djérid tunisien. Par E. du Fresnel.

Uganda. *B.S.G. Italiana* **5** (1904): 1076-1089. **Castellani and Mochi.**
Contributo all' Antropologia dell' Uganda dei dottori A. Castellani e A. Mochi.

West Africa. *La G., B.S.G. Paris* **11** (1905): 97-107. **Cureau.**
Travaux astronomiques et topographiques de la Mission française de délimitation entre le Congo français et le Cameroun. Par Dr. A. Cureau. *With Map and Illustrations.*

West Africa. **Field.**
"Verb. Sap." on going to West Africa, Northern Nigeria, Southern, and to the Coasts. By A. Field. London: Bale, Sons & Danielsson, [1905]. Size 7½ × 5, pp. 166. *Map and Illustrations. Price* 2*s.* 6*d. Presented by the Author.*
See note in *Journal* for February, 1905, p. 204.

West Africa. *A travers le Monde* **11** (1905): 53-54. ——
La Mission ichtyologique de la Baie d'Arguin. *With Map.*

NORTH AMERICA.

United States—Communications. ——
Department of Commerce and Labour, Bureau of the Census. Special Reports. Street and Electric Railways. Washington, 1905. Size 12 × 9½, pp. x. and 440. *Maps and Illustrations.*

United States—Great Basin. *J. Geology* **13** (1905): 63-70. **Keyes.**
Structures of Basin Ranges. By C. R. Keyes. *With Illustrations.*

United States—Historical. **Ford.**
Library of Congress. Papers of James Monroe listed in chronological order from the original manuscripts in the Library of Congress. Compiled under the direction of W. C. Ford. Washington, 1904. Size 11 × 7½, pp. 114.
The papers date from 1779 onwards, and include a facsimile of Monroe's journal of negotiations for the Louisiana purchase.

United States—Levelling. *Science* **21** (1905): 673—674. **Hayford.**
A connection by Precise Leveling between the Atlantic and Pacific Oceans. By Dr. J. F. Hayford. [See also p. 862 of the same vol.]
See note, *ante*, p. 220.

United States—Louisiana. *Science* **21** (1905): 551-552. **Hilgard.**
The Prairie Mounds of Louisiana. By Prof. E. W. Hilgard. [See also pp. 310, 632 of the same vol., and p. 358, *supra* (Geomorphology).]
Noticed in the Monthly Record.

United States—Massachusetts. **Goldthwait.**
B. Museum Comparative Zoology Harvard College **42** (1905): 263-301.
The Sand Plains of Glacial Lake Sudbury. By J. W. Goldthwait. *With Map and Plates.*

United States—New York. *B. American G.S.* **37** (1905): 65-77. **Haupt.**
A Menace to the New York Harbour Entrance. By L. M. Haupt. *With Chart.*

United States—New York. *B. American G.S.* **37** (1905): 193-212. **Tarr.**
The Gorges and Waterfalls of Central New York. By R. S. Tarr. *With Map and Illustrations.*

United States—Place-names. *National G. Mag.* **16** (1905): 100-104. **Whitbeck.**
Geographic Names in the United States and the stories they tell. By R. H. Whitbeck.

United States—Tennessee. *J.G.* **4** (1905): 58-73. **Emerson.**
Physiographic Control of the Chattanooga Campaign. By F. V. Emerson. *With Maps and Illustrations.*

United States—Washington. *Science* **21** (1905): 392-393. **Conard.**
The Olympic Peninsula of Washington. By H. S. Conard.

CENTRAL AND SOUTH AMERICA.

Peru—Historical. **Lamprey.**

Selections from Prescott's History of the Conquest of Peru. Edited by A. S. Lamprey. London: H. Marshall & Son, 1905. Size 7½ × 5, pp. 132. *Maps and Illustrations. Price* 1*s.* 3*d. Presented by the Publishers.*

Intended as a reading-book for schools.

Peru—Manu. *B.S.G. Lima* **15** (1904): p. 120. **Torres.**

Plano del rio Manu, y perfil longitudinal del talweg del mismo rio. Por el ingeniero Juan M. Torres. *Map and Sections only.*

A reduction of the original survey (cf. *Journal*, **23**, p. 606), but on the large scale (longitudinal) of 1 : 60,000. The scale of widths is exaggerated three times, involving some distortion, and the orientation seems incorrect, as it indicates the river's general direction as far less inclined to an east-and-west line than in all other recent maps, including the latest publications of the Junta de Vias Fluviales.

Tierra del Fuego. *B.I.G. Argentino* **21** (*n.d.*): 3–78. **Dabbene.**

Viaje á la Tierra del Fuego y á la Isla de los Estados. Por R. Dabbene.

Uruguay. ———

Años 1902 y 1903. Anuario Estadístico de la República O. del Uruguay. Tomo i. Montevideo, 1905. Size 11½ × 8, pp. xxiv. and 764. *Diagrams. Presented by the Director-General de Estadística, Montevideo.*

West Indies—Bahamas. **Shattuck.**

The Geographical Society of Baltimore. The Bahama Islands. Edited by G. B. Shattuck, PH.D. New York: The Macmillan Company, 1905. Size 11 × 7½, pp. xxxii. and 630. *Maps and Illustrations. Price* 42*s. net. Presented by the Editor.* [To be reviewed.]

MATHEMATICAL GEOGRAPHY.

Mathematical Geography. **Marcuse.**

Handbuch der Geographischen Ortsbestimmung für Geographen und Forschungsreisende. Von Dr. Adolf Marcuse. Braunschweig: F. Viewig und Sohn, 1905. Size 9 × 6, pp. x. and 342. *Charts and Illustrations. Price* (*half-leather*) 12 *marks, and* (*unbound*) 10 *marks. Two copies, presented by the Publishers.* [To be reviewed.]

PHYSICAL AND BIOLOGICAL GEOGRAPHY.

Oceanography. **Monaco.**

Résultats des Campagnes scientifiques accomplies sur son yacht par Albert Ier Prince Souverain de Monaco publiés sous sa direction avec le concours de M. J. Richard. Fasc. XXIX. Mémoires Océanographiques. (Première série.) Par J. Thoulet. Monaco, 1905. Size 14 × 11½, pp. 134. *Plates. Presented by H.S.H. the Prince of Monaco.*

Oceanography. **Raben.**

Weitere Mitteilungen über quantitative Bestimmungen von Stickstoffverbindungen und von gelöster Kieselsäure im Meerwasser. Von Dr. E. Raben. (Separatabdruck aus: Wissenschaftliche Meeresuntersuchungen herausgegeben von der Kommission zur Untersuchung der deutschen Meere in Kiel und der Biologischen Anstalt auf Helgoland, Abt. Kiel., N.F., Bd. 8.) Kiel, 1905. Size 13 × 10½, pp. 279–287. *Charts. Presented by the Deutschen Wissenschaftlichen Kommission für die Internationale Meeresforschung.*

Oceanography. **Stenius.**

Öfversigt Finsk. Vet.-S. Förhandlingar **46** (1903–4): No. 6, pp. 16.

Der osmotische Druck im Meerwasser. Mitteilung aus dem Laboratorium der Finnischen hydrographisch-biologischen Kommission. Von S. Stenius.

Oceanography. *Ann. Hydrographie* **33** (1905): 206–211. **Wegemann.**

Ursachen der vertikalen Temperaturverteilung im Weltmeere unter besonderer Berücksichtigung der Wärmeleitung. Von Dr. G. Wegemann.

Oceanography—Currents. *La G., B.S.G. Paris* **11** (1905): 185–190. **Bénard.**

Les courants du golfe de Gascogne. Par C. Bénard. *With Map.*

Oceanography—Mediterranean. ———

Berichte Commission Oceanograph. Forsch. **8** (1904): 285–323.

Fortsetzung der Berichte der Commission für Erforschung des östlichen Mittelmeeres. (Achte Reihe.)

Oceanography—Pacific. *American J. Sci.* **19** (1905): 274–276. **Agassiz.**

On the progress of the *Albatross* Expedition to the Eastern Pacific. By A. Agassiz.

Oceanography—Red Sea. ———

Berichte Commission Oceanograph. Forsch. **8** (1904): 1–283.

Fortsetzung der Berichte der Commission für oceanographische Forschungen im Rothen Meere (Südliche Hälfte) 1897–1898. *With Maps and Plates.*

Sea-level. **Steenstrup.**

Kan Tangranden benyttes til Bestemmelse af Forandringer i Vandstanden? Af K.J.V. Steenstrup. (Særtryk af "Meddelelser om Grønland," **33**.) København, 1905. Size 9½ × 6, pp. 8. *Plates. Presented by the Author.*

Discusses the possibility of determining recent fluctuations of level by a study of the seaweed fringe on cliffs, etc.

Seismology. **Láska.**

Ueber die Verwendung der Erdbebenbeobachtungen zur Erforschung der Erdinnern. Von Prof. Dr. W. Láska. (Mitteilungen Erdbeben-Kommission der K.A.W. Wien, N.F., No. xxiii.) Wien, 1904. Size 9½ × 6½, pp. 14. *Presented by the K. Akademie der Wissenschaften, Vienna.*

Springs. *Meteorolog. Z.* **22** (1905): 159–164. **Kerner.**

Ueber die Abnahme der Quellentemperatur mit der Höhe. Von Dr. F. v. Kerner.

Terrestrial Magnetism. *Terrestrial Magnetism* **9** (1904): 163–166. **Bauer and Littlehales.**

Proposed Magnetic Survey of the North Pacific Ocean by the Carnegie Institution. By L. A. Bauer and G. W. Littlehales.

See note in the April *Journal* (p. 462).

Tides. **Zöppritz.**

Gedanken über Flut und Ebbe. Widerlegung der herrschenden Ansichten über deren Entstehung, und Vergleich mit ähnlichen in Wassermassen auftretenden Erscheinungen. Von A. Zöppritz. Dresden: H. Schultze, 1904. Size 9½ × 6½, pp. vi. and 62. *Presented by the Publisher.*

Volcanoes. *Sitzb. A.W. Wien* **112** (1903), Abt. I.: 681–705. **Doelter.**

Zur Physik des Vulkanismus. Von C. Doelter.

ANTHROPOGEOGRAPHY AND HISTORICAL GEOGRAPHY.

Historical. **Dias.**

B.S.G. Lisboa **21** (1903): 180, 222, 291, 336, 377, 402; **22** (1904): 11, 78, 135, 160, 200, 248, 308, 339, 367, 414.

O Esmeraldo de Duarte Pacheco, edição critica por A. Epiphanio da Silva Dias.

Historical—Behaim. *B.S.G. Lisboa* **22** (1904): 297–307. **Serpa.**

Martinho de Bohemia (Martin Behaim) (Excerpto). Por A. Ferreira de Serpa.

Mamiya. *J.G., Tōkyō G.S.* **16** (1904): 541–623. **Ogawa.**

Rinzo Mamiya. I. Life and Works of Rinzo Mamiya. By T. Ogawa. II. Mamiya's Unpublished Works. 1. Report of Mamiya's Expedition to Saghalien, with Account of Matsuda's Trip to the Farthest Part of the Island. 2. Mamiya's Travel to East Manchuria ("Tōdatsukikō"). [In Japanese.] *With Maps and Plates.*

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See note on other vols. of the series in vol. **25**, p. 236.

Geography. **Havass.**

Evénements géographiques de l'année 1903. Par Dr. R. Havass. Budapest, 1904. Size 9 × 6½, pp. [18]. *Presented by the Author.*

Geography—Text-book. **Heighway.**

Ai Vola ni Jiokarafi kei Europe kei Aferika. Sa vakarantaka ko W. A. Eiwei (Rev. W. A. Heighway). pp. 144 and xii. Ditto, kei Esia kei Amerika, pp. 84 and iv. Fiji: District Printing and Publishing Committee, 1904. Size 5 × 7¼. *Maps and Illustrations. Presented by the Author.*

A text-book of geography for use in Fiji.

Year-book. **Klein.**

Jahrbuch der Astronomie und Geophysik. . . . Herausgegeben von Prof. Dr. H. J. Klein. XV. Jahrgang 1904. Leipzig: E. H. Mayer, 1905. Size 9 × 6, pp. viii. and 344. *Diagrams and Illustrations.*

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World. **Stieler.**

Neue, neunte Lieferungs-Ausgabe von Stielers Hand-Atlas. 100 Karten in Kupferstich herausgegeben von Justus Perthes' Geographischer Anstalt in Gotha. 49 und 50 Lieferung. Titel, Inhaltsübersicht und Namenverzeichnis zur neunten, von Grund aus neubearbeiteten und neugestochenen Auflage. Gotha: Justus Perthes.

This issue, containing sheets 3 and 4 of the map of Africa, and 1 and 3 of South America, completes the ninth edition of this well-known and excellent atlas. The first part was published four years ago, and was noticed in the *Geographical Journal* for January, 1902. Many entirely new maps have been added, and the others carefully revised and brought up to date. The principal alteration in the general appearance of the maps is in the hill features, which are in this edition for the first time printed in brown instead of black, and in some respects this is an improvement, inasmuch as it renders it possible to read the place-names more readily. Still, on some of the maps the shading is somewhat rough, and the fineness of execution which characterized the earlier editions is wanting. But when it is remembered that the whole atlas, including one hundred maps, can be now obtained for 30 marks, it must be admitted that it is a most remarkable production for the money, and considering the amount of accurate information it contains, and the general excellency of the maps, the atlas deserves to be even more popular than it has been hitherto.

With this issue there also appears the index to place-names, which is most complete, and will add greatly to the value of the atlas for purposes of general reference. An extra charge of 3.50 marks is made for this index.

CHARTS.

Chile. **Chilian Hydrographic Office.**

Chilian Hydrographic Chart, No. 110, Canal Smyth, Bahia Muñoz Gamero. Valparaiso: Oficina Hidrografica, Marine de Chile, 1905. *Presented by the Chilian Hydrographic Office.*

Guam. **U.S. Hydrographic Office.**

The Island of Guam. From a topographical survey in 1901–1902, under the direction of Civil Engineer Leonard M. Cox, U.S. Navy. Scale 1 : 56,070 or 1·13 inch to a stat. mile. Washington: U.S. Hydrographic Office, 1904.

This chart is on a large scale, and measures 44 × 32 inches. It shows a considerable amount of detailed information, not merely round the coast-line, but also in the interior of the island.

North Atlantic Ocean. **Kaiserliche Marine, Deutsche Seewarte.**

Monatskarte für den Nordatlantischen Ozean. August, 1905 (Jahrgang 5), No. 8. Hamburg: Kaiserliche Marine, Deutsche Seewarte, 1905. *Price 75 pfg.*

The special feature of this issue of the German official monthly pilot chart of the North Atlantic is, that on the back full particulars are given of the eclipse of the sun of August 29 and 30, accompanied by a chart. The pilot chart itself is very similar in general design and the character of the information it contains, to that of our own country and the United States.

North Atlantic. **U.S. Hydrographic Office.**

Pilot Chart of the North Atlantic Ocean for August, 1905. Washington: U.S. Hydrographic Office, 1905. *Presented by the U.S. Hydrographic Office.*

North Pacific. **U.S. Hydrographic Office.**

Pilot Chart of the North Pacific Ocean for September, 1905. Washington: U.S. Hydrographic Office, 1905. *Presented by the U.S. Hydrographic Office.*

PHOTOGRAPHS.

Kordofan. **Leveson.**

Eighteen photographs of Southern Kordofan, taken by Captain C. H. Leveson, 18th Hussars. *Presented by Captain C. H. Leveson.*

The district in which these photographs were taken extends from 9° 30′ to 12° N. lat. and 30° to 32° E. long., and includes the part of Kordofan west of the valley of the Nile at Fashoda. The photographs are specially interesting from an anthropological point of view, and the dances are extremely well taken.

(1 and 2) A Nuba mountain village; (3) Nubas of Kawarma; (4) Nuba men of Kawarma dancing; (5) Nubas of Jebel Tatcho; (6) A Nuba of Jebel Timin; (7–9) Nuba women dancing at Tira el Akhdar; (10) A Nuba woman of Acheron; (11) A Nuba woman of Ghulfan; (12 and 13) Nuba babies eating sugar; (14 and 15) Wrestlers of Jebel el Aheima; (16) A Nuba of Nyima; (17) A tebeldi tree; (8) Dinkas near the mouth of the Bahr el Arab.

South Africa. **Ritchie.**

Twenty-five photographs of the Drakensberg mountains, Barotseland, and the Victoria Falls, and eleven drawings from some Bushman's caves, taken by Captain C. Mac I. Ritchie, R.H.A. *Presented by Captain C. Mac I. Ritchie, R.H.A.*

An interesting little set of photographs and sketches, to the value of which Captain Ritchie has added considerably by the careful and complete descriptions he has furnished with them. The copies of the drawings in the Bushman's caves, in the Drakensberg mountains, are specially interesting.

(1) Head of Bushman's river; (2) Looking out from Bushman's caves; (3) Nearing the head of Bushman's river; (4) The top of Bushman's river pass; (5) Party returning from pass; (7 and 8) Victoria falls, river entering the gorge; (9 and 10) Victoria falls; (11) The "Knife Edge," Victoria falls; (12) The Zambezi in the gorge; (13) Camp on the Ingwesi river; (14) Hanging birds' nests; (15) Carriers on the march; (16) A Barotse kraal; (17) Donkey transport on the march; (18) A baobab tree; (19 and 23) A blue wildebeeste bull; (20) A Barotse carrier; (21 and 22) Catching and loading "pack-donkeys;" (24) The Zambezi at Kasangula; (25) Lichtenstein hartebeeste.—Drawings: (1) A Bushman attacking a Kaffir; (2) The leader of the community, laying down the law; (3) Bushman after shooting arrow; (4) Kaffir babies fighting; (5) Kaffir running; (6) European with gun; (7) A Bushman resting on his bow; (8) Two Bushmen going hunting; (9) An eland walking; (10 and 11) An eland standing still.

Vegetation types. **Karsten and Schenck.**

Vegetationsbilder, herausgegeben von Dr. G. Karsten und Dr. H. Schenck. Dritte Reihe, Heft 2. Russisch Turkestan. Von Dr. E. A. Bessey. Heft 4. Mittel- und Ost-Java. Von Dr. M. Büsgen, Dr. H. Jensen und Dr. W. Busse. Jena: Gustav Fischer, 1905.

N.B.—It would greatly add to the value of the collection of Photographs which has been established in the Map Room, if all the Fellows of the Society who have taken photographs during their travels, would forward copies of them to the Map Curator, by whom they will be acknowledged. Should the donor have purchased the photographs, it will be useful for reference if the name of the photographer and his address are given.

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KASHMIR
R. INDUS (Gartang Cha)
20750
Dronnanara
Leo Pargial
22200
Shipki La
15400
Khab
Pangrang La
Pimikchu La
19000
Thaga La
Chirbittia or Manirang
17800
Kangmen
25430
18250
Kungribingri La
16260
Nanda Devi
25660
Pan
NORTH WESTERN PROVINCES
Kashgar
75
80
85
TAKLA MAKAN
CHINESE TURKISTAN
DESERT
Yarkand R.
Yarkand
Khotan
Khotan R.
Keriya
Keriya R.
Polu
KWEN LUN
Karakoram P.
Jiggitai
L. Markham
KASHMIR
Leh
Shrinagar
Indus
Dudok
Thipki P.
Gartok
PUNJAB
R. Sutlej
Simla
Sutlej R.
Rakas Tal
Manasarowar L.
Pangra
Pun
Dzo
Meerut
Delhi
Rongbo
Rega Ta
RAJPUTANA
R. Ganges
R. Jumna
GANGETIC PLAIN
Eve
Dar
BEN
Patna
R. Ganges
Scale of Miles
100 50 0 100 200 300 200
Nat. Scale 1:20,000,000 or 316 miles = 1 inch
Secant Conical Projection

TIBET

Map showing Explorati

by

MAJOR C.H.D.RYDER, R.E

and

CAPTAINS H.WOOD, R.E. & H.M.C

OF THE

TIBET FRONTIER COM

1904.

Reduced from the Sheets of the Survey

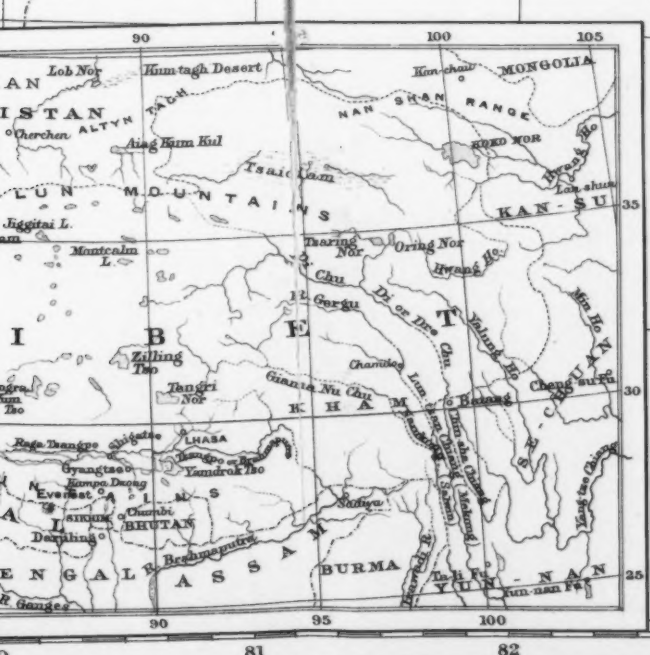
Scale of Miles.

20 10 0 20 40 60

Nat. Scale 1: 2,500,000 or 39·45 miles

Route of Expedition

Heights in feet.



Published by t

I B E T

howing Explorations

by

I.D. RYDER, R.E., D.S.O.

and

OOD, R.E. & H.M. COWIE, R.E.

OF THE

NTIER COMMISSION.

1904.

e Sheets of the Survey of India.

Scale of Miles.

20 40 60 80 100

1: 2,500,000 or 39·45 miles = 1 inch.

of Expedition ———

Heights in feet.

CHART OF TRIANG

Scale 1: 2,500,000

Everest 29002

B

A

L

Snowy Range

Tsang La

Gaurisankar

Everest

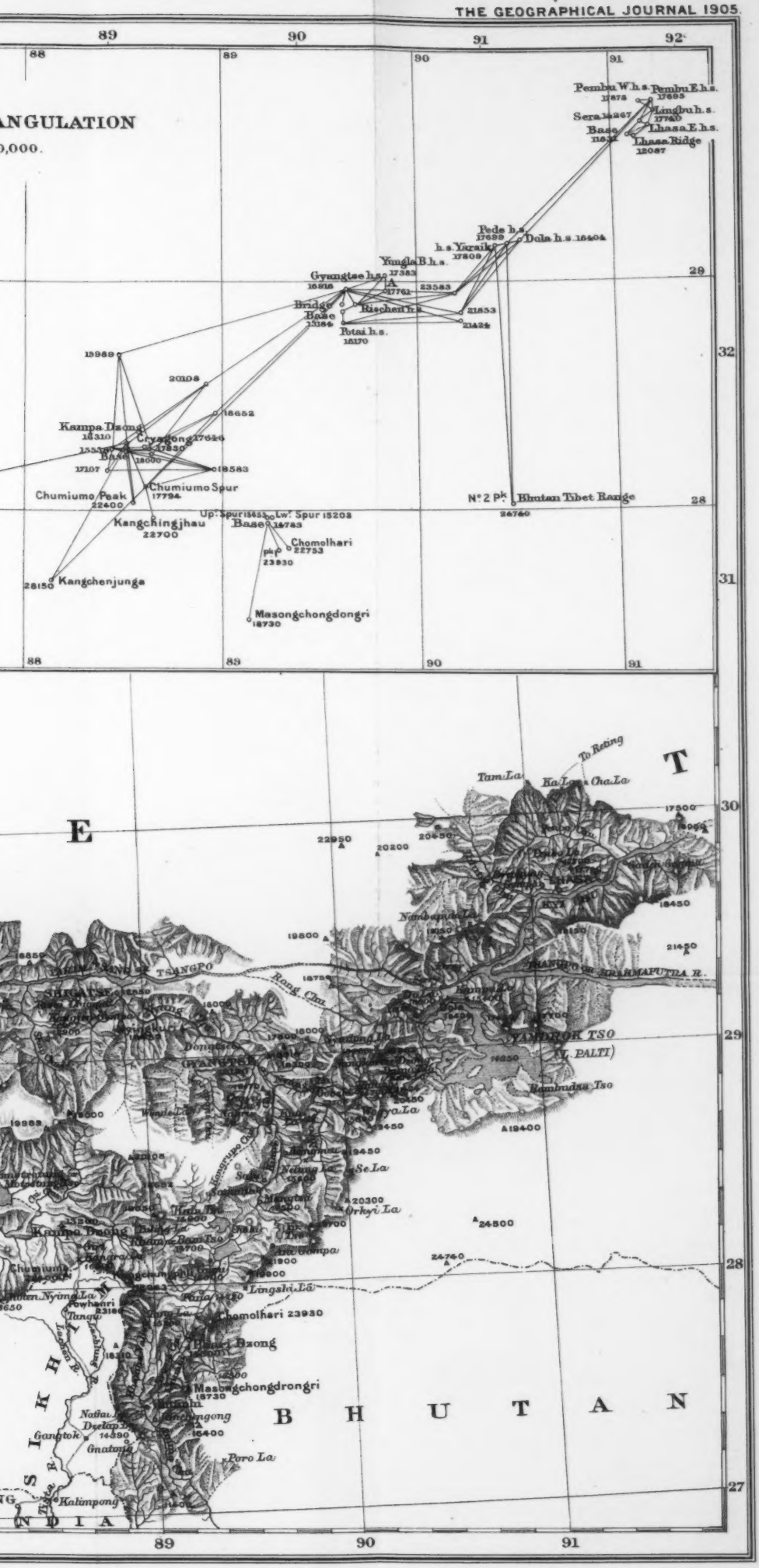
Makulu

Kangchanjunga

Arun R.

DARJILING

Published by the Royal Geographical Society


89
90
91
92
88
ANGULATION
0,000.
Pembu W.h.s. 17678
Pembu E.h.s. 17695
Sera 17267
Lingbu h.s. 17740
Base 17531
Lhasa E.h.s.
Lhasa Ridge 12087
Pede h.s. 17699
Dola h.s. 16404
h.s. Yaraik 17808
Yungla B.h.s. 17383
Gyemgtse h.s. 16918
23583
21761
Bridge
Base 13164
Riechen h.s.
21853
21424
Potai h.s. 16170
29
32
13989
20108
18652
Kampa Dzong 16310
Chyagong 17620
17830
18440
18000
17107
18583
Chumiomo Spur 17794
Chumiomo Peak 22400
N° 2 Pk 26740
Bhutan Tibet Range
28
Kangchingjhau 22700
Up. Spur 15653
Lwr. Spur 15203
Base 14783
Chomolhari 22753
pk 23930
Kangchenjunga 28150
31
Masongchongdongri 18730
88
89
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T
E
To Rating
Tam La
Ka Lagoa Cha La
17300
18050
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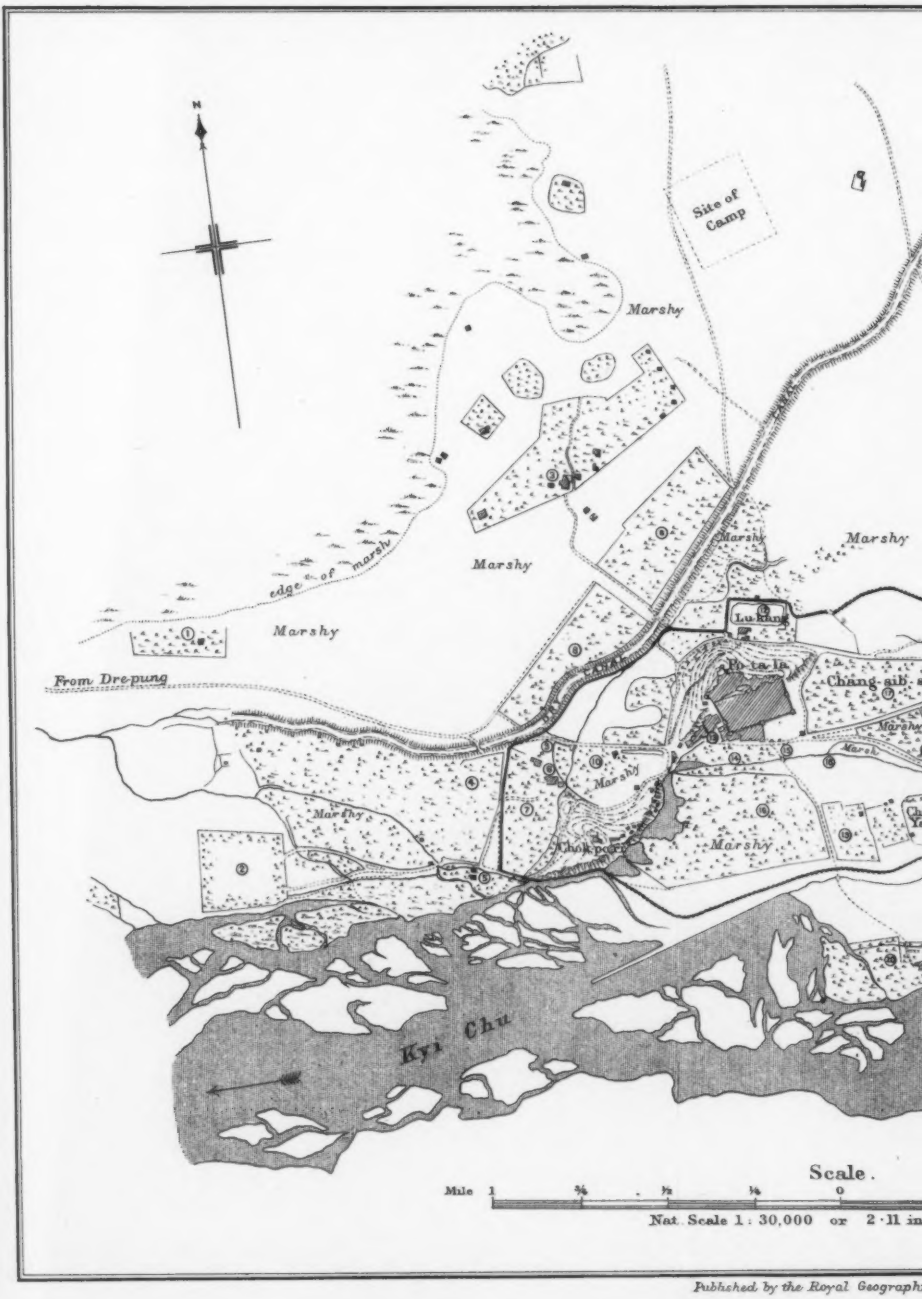
22950
20200
20450
Dzaka La
Nambugan La
18450
19800
18150
21450
TSANGPO OR BRAHMAPUTRA R.
Rong Chu
18750
YAMDROK TSO
(Y. PALTI)
29
Rambudze Tso
19400
Karo La
Se La
Orkyi La
24500
24740
28
Lingshi La
Chomolhari 23930
Bzong
Masongchongdrongri
18730
B H U T A N
Paro La
27
Kalimpong
I N D I A
89
90
91



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THE GEOGRAPHICAL JOURNAL 1905.

PLAN OF LHASA.

From a Survey by
MAJOR C.H.D. RYDER R.E., D.S.O. AND CAPT.N H.M. COWIE R.E.
1904.

Reference.

1	Ka-je Linga	19	Shing-ra Linga	37	Gya-ok-kang
2	Nor-bu "	20	Ku-ma "	38	Muruk Gompa
3	Lha-lu	21	Ka-chu-gye	39	Mintol Bridge
4	Tö-gyak Linga	22	Nyer-tsang Linga	40	Tsang-kang Nunnery
5	De-kyi "	23	Ramoche	41	Gya-ka-je-lha-kang
6	Kun-de "	24	Ra-tring	42	Ra-jok Linga
7	Kun-de-ling Linga	25	Tso-mon-ling-chora	43	Po-tri "
8	Jara Linga	26	Ganden-kang-sar	44	Muru "
9	Ba-ma-ri	27	Shi-de Gompa	45	Chang-dzo "
10	Par-shi Linga	28	Tso-mon-ling Gompa	46	Pa-no "
11	Par-go-kaling	29	Ten-gye Linga	47	Shi-de "
12	Lu-kang	30	Yutok	48	Ka-mar-shar Linga
13	Sho	31	Yutok-rampa	49	Tso-mon Linga
14	Do-pe Linga	32	Lubuk-gutang	50	Par-re "
15	Do-ring	33	Po-tri-kang-sar	51	Pe-ling-shi "
16	Shuk-tri Linga	34	Yap-chi-sarpa	52	De-kyi Linga
17	Chang-sib-shar	35	Shing-ra Linga		
18	Yutok Linga	36	Ten-pe "		

The Ling Kor (pilgrim's road.) is shewn by a black line, length 5 miles.
Linga = Summer residence with garden.
Gompa = Monastery

·11 inches = 1 mile.

36°15'
30'
45'
0
15'
30'
45'
1°
15'
30'
Pesi Swamp
Lake El Barrossa
Baldorota
Satima
Mt. Kora
Kibibari
Eburru
Mt. Kinangop
Naivasha
Lake Naivasha
Mt. Longonot
Mt. Suswa
Ingong's Hills
R. Moyo
R. Chania
R. Kedong
KIKUYU ESCARPMENT
NANDI ESCARPMENT
Ndabibi Plain
Kinabe
Published by the Royal Geog

37°
15'
30'
BRITISH EAST AFRICA.
Plane Table Sketch of the
COUNTRY WEST OF
Mt KENYA
By Capt. R. Meinertyhazen
(Royal Fusiliers)
1903.
Scale of Miles.
10 5 0 10 20
Nat. Scale 1 : 1,000,000 or 15·78 stat. miles = 1 inch.
Author's Route
Heights in Feet
45'
0°
15'
30'
45'
1°
15'
30'
37°
15'
30'
R. Enkare
R. Mizigo
R. Nairobi
Kabete
Kikuyu
Kedong
R. Ragati
R. Ruchuruchu
R. Kruminduti
R. Mbagathi
R. Mbagathi
R. Kiu
R. Mbagathi
R. Mbagathi
R. Mbagathi